ROADS AND STREETS

Design, Construction, Maintenance and Traffic Control

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Great Old Stone Bridge on the National Road near Grantsville, Md.

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ROADS AND STREETS

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Vol. LXXI *Chicago, May, 1931* *No. 5*

Surface About One Month After Completion of Treatment

A Widening, Smoothing and Resurfacing Operation with Unorthodox Features

By J. R. McDERMOTT

District Engineer, State Road Commission of West Virginia, Keyser, W. Va.

ON U. S. Route 11, the heaviest interstate traffic route in the eastern panhandle section of West Virginia, there was carried on during the 1930 season a widening and resurfacing project with certain unorthodox features. The section under discussion was a project 4.87 miles in length lying in the Shenandoah Valley between the cities of Martinsburg and Winchester and carrying an average traffic of 1,077 vehicles per 16-hour day as shown by a full-week mid-August count. Of this traffic 59 per cent was cars and trucks from states other than West Virginia.

In 1922 this project had been surfaced with 2 in. of bituminous concrete on a stone base. The base was roughly similar to present-day traffic-bound surfaces, and had developed by the yearly addition of crushed limestone to the traveled roadway, the stone grading mostly under 1¼ in. with an excess of fines, including dust. The base had been reshaped and compacted, after plugging and adding stone to insure a minimum 5-in. depth, before the top course was constructed. The wearing surface had a width of 18 ft., and shoulders 5 ft. in width were built of quarry spoil borrowed from the waste banks of local commercial limestone quarries. This spoil consisted of a mixture of clay and limestone spalls, 75 per cent or more being stone with a range of from 2 to 5 in. in size, the mixture compacting rapidly and solidly. During an 8-year period of usage the bituminous surface had become rather wavy, caused, in the main, by unequal base-course strength and natural subgrade subsidence. The surface was also very badly haircracked, many of the cracks being of such size that they were being maintained by crack pouring. Some small areas had also been squeegeed or surface-treated. It was evident, however, that a squeegee coat, while it

might enliven the surface, would not suffice, because of the need for improved riding qualities. In the fall of 1929 the pavement showed an average roughometer factor of 240 half-inches of surface variation per mile. It was therefore determined to surface-treat the road during the following year and planned that a drag treatment should be used.

As the first step toward dressing-up the roadway, limestone screenings were added to the shoulders to furnish a mulch for blade maintenance operations. These screenings were cheaply available from waste storage at near-by quarries and were loaded by belt conveyor into state-owned motor trucks for an average 9-mile haul to the project. By selection the material obtained was rather free from dust and was all under 1¼ in. in size, approximately 75 per cent being under ¾ in. and over ⅜ in. It was thought that the addition of this stone would result in obtaining practically traffic-bound shoulders. A small trench 2 ft. in width and 2 in. in depth was first cut at the edge of the pavement, removing surplus clay which had accumulated on the quarry-spoil shoulders through the addition of shoulder material as the spoil had compacted. A drawn grader, to the moldboard of which there had been affixed a short blade or cutting edge 3 ft. in length and 2½ in. in depth, very satisfactorily cut this trench, as the cutting edge when at the proper operating angle to the pavement centerline automatically gauged the width and depth. The moldboard also distributed and smoothed out the excavated material on the shoulder in one operation with the trenching. Into this trench the limestone screenings or

Fig. 1—Surface before Treatment. Screening Shoulders in Place; also Chips and Sand for Cover Coat Distributed

chips were directly deposited from dump trucks equipped with tail-gate chutes, the trucks straddling the trench and discharging their loads in a narrow windrow as they moved forward parallel to the pavement edge. A power grader immediately smoothed the deposited screenings, this work thus requiring the minimum of hand labor.

The material was added to the shoulders in March in anticipation of softened spring soil conditions facilitating compaction. The screenings were smoothed twice weekly or oftener by a light broom-drag device which was more economical in operation than a power or drawn grader. This broom drag, pictured in Fig. 2, consists of a light wood frame carrying two wire pushbrooms on both cross-

Fig. 2 (above)—Spike Harrow and Broom Drag in Action, Stirring and Smoothing Narrow Retread Widening

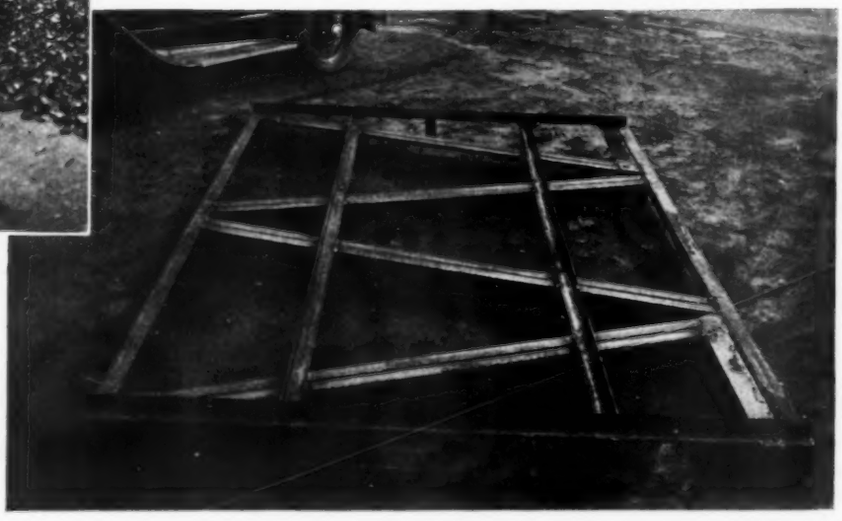


Fig. 3 (right)—Type of Drag Used to Distribute Cover Coat. Three Steel Blades Stirred and Mixed Chips and Rear Broom Blade Distributed Them

Fig. 4 (right) — Surface in Midwinter, about 7 Months after Treatment. Road Section Had Been Widened to 38 Ft. by Addition of 8-Ft. Quarry-Spoil Shoulders on Each Side

Fig. 5 (below)—Texture of Retread Shoulders in March, 1931

members, and equipped with a steering handle at the rear. The corners of the frame were bolted so that the angle at which the brooms swept toward the pavement edge was adjustable. In operation the broomdrag was pulled by a light truck with an offset hitch bar so that the outer truck wheels ran at the pavement edge and a laborer sitting in the rear of the truck bed steered the brooms as necessary. After several weeks of this manipulation it became evident that the screenings shoulders were not going to bind up, due to lack of fines, to the solid character of the quarry-spoil subgrade or base and to the lack of moisture at the beginning of a droughty season. Plans for consolidating this shoulder material were therefore revised, and it was decided to proceed with retread construction of those shoulders, the subgrade having the apparent required stability.

In proceeding with this retread, an asphaltic oil was purchased for reasons of economy. The specifications for this asphalt oil follow:

	Minimum	Maximum
1. Specific gravity at 15.5 deg. C.	0.980	1.01
2. Specific viscosity, Engler, first 50 c.c. at 100 deg. C.	25	50
3. Asphalt content at 100 penetration, per cent	85	
4. Ductility of residue at 25 deg. C. in cms.	100	
5. Evaporation loss 20 g., 5 hours at 100 deg. C., per cent	10.0	13.0
6. Penetration of residue at 25 deg. C.		200
7. Evaporation loss 50 g., 5 hours at 164 deg. C., per cent	12.0	15.0
8. Penetration of residue at 25 deg. C.		125
9. Bitumen soluble in carbon disulphide, per cent	99.5	
10. Total bitumen insoluble in 86 deg. Baumé naphtha, per cent	20.0	

The oil was very slightly heated to a temperature of approximately 100 deg. F. and was applied by an ordinary pressure distributor equipped with a shortened spray bar. Only one application of retread asphalt was made, at a rate of 0.557 gal. per sq. yd.

Because of the narrowness of the retread surface being constructed, it was previously obvious that the usual methods of manipulating a retread could not be followed. There had therefore been prepared a narrow spike-tooth harrow, this being the first idea of a suitable manipulation device. This harrow was exceptionally simple in design, consisting of a double staggered row of 6-in. railroad spikes spaced 4 in. in each row, force-fitted into holes bored through two 3x3-in. timbers bolted together. The teeth thus projected 3 in. beneath the timbers, and the out-to-out spacing of the spikes was 2 ft. The harrow was weighted with a bag of sand and was equipped with a towing bar, being pulled by a light truck with offset hitch. In a redesign of this harrow the number of teeth would be increased to four or more rows. Immediately behind this spike harrow was fastened the wire-broom drag previously described for smoothing the untreated screenings. The combined outfit is illustrated in Fig. 2. This combination worked quite satisfactorily; the stirring action of the spike teeth resulted in thorough admixture of asphalt and stone and the broom drag following smoothed the retread mix efficiently. Six or eight stirrings of the mix were possible before it became tacky, after which time it was compacted under the rear wheel of a 10-ton roller.

In the meantime patching of the major depressions in the bituminous concrete surface was proceeding, a poured-type patch being used. In making these patches the entire surface was straightedged, but only those depressions which showed a greater depth than ¾ in. beneath a 10-ft. straightedge were filled, it being anticipated that the lesser waves would be mechanically filled by dragging the surface-treatment cover. Depressions were filled with dry chips, struck and straightedged, sprayed with asphalt cold-patch oil from an ordinary water sprinkler, lightly sanded and left for traffic to compact, a very limited use of a light roller being made on a portion of the work. This portion of the work was finished simultaneously with the retread edges and the entire 22-ft. width of surface was in readiness for seal coating.

Asphalt suitable for cold application was selected for the seal, the asphaltic material meeting the following specification:

	Minimum	Maximum
1. Specific gravity at 15.5 deg. C.	0.940	0.9650
2. Flash point, open cup, deg. C.		35
3. Specific viscosity, Engler, first 50 c.c. at 50 deg. C.	18	30
4. Asphalt content at 100 penetration	68	
5. Evaporation loss 20 g., 5 hours at 100 deg. C. per cent	20	
6. Evaporation loss 50 g., 5 hours at 160 deg. C., per cent	27	
7. Penetration at 25 deg. C. on residue from 163 deg. C., evaporation test		200
8. Bitumen soluble in carbon disulphide, per cent	95.5	
9. Total bitumen insoluble in 86 deg. Baumé naphtha, per cent	15.0	
10. Distillation:		
Per cent up to 150 deg. C.	5	10
Per cent up to 200 deg. C.	24	29
Per cent up to 205 deg. C.		32

The rate of application was 0.248 gal. per sq. yd., and the oil, while intended for cold application, was slightly heated, being applied at 100 to 125 deg. F.

The cover coat had previously been distributed in 1,000-lb. piles at the roadside, spaced to supply 30 lb. of ⅝ to ⅜-in. limestone chips and 10 lb. of gritty white sand per square yard. This sand was from crushed silica sandstone, a by-product of commercial glass-sand plants within short shipping radius, and roughly resembled standard Ottawa sand as will be seen from the following mechanical analysis:

Fraction	Per Cent
Retained on ¼-in. screen	None
Passing ¼-in. screen, retained on 10-mesh	0.0
" 10-mesh on 20-mesh	19.8
" 20 " " 30 "	72.0
" 30 " " 40 "	4.6
" 40 " " 50 "	2.2
" 50 " " 80 "	1.1
" 80 " " 100 "	0.3
" 100 " " 200 "	0.0
" 200-mesh	0.0
Total	100.0

The asphalt was applied to a half-width of roadway at one time and one-way traffic was maintained on the other half. The proper amount of stone cover was immediately applied by workmen who had been stationed at such intervals that each man was assigned a definite quantitative task and that the application of cover coat was simultaneously under way at a score of points along the asphalt swath behind the distributor. Almost at once the surface-dragging was begun. For this purpose there was made an adaptation of a drag developed in Ohio primarily for use on traffic-bound stone surfaces.

This drag, with a width of 8 ft. and an overall length or "wheelbase" of 12 ft., consisted of four transverse blades alternately angled in opposite directions between side blades or runners which prevented the lateral escape of the asphalt-impregnated chips. For the usual rear steel blade there had been substituted a battery of steel wire pushbrooms which smoothed and distributed the oily chips coated by the action of the three front blades. The wire brooms were of the round wire type and somewhat stiffer than the usual push broom, the bristles being of 24-gauge wire. (See Fig. 3.) Chips were left deposited in the minor depressions as expected and the high points of the wavy surface were left greasy and bare of cover. As anticipated, the surface behind the drag was unfit either to be rolled or to be traveled by the impatient public. The sand had been supplied to remedy this condition and a small gang followed immediately behind the drag applying this second cover coat, which dried up the greasy high spots and partially filled the voids in the material left in the low points.

QUANTITY AND COST TABLE

	Total	Quantities and Cost per Sq. Yd.
Limestone screenings for shoulders	987.0 tons	172.7 lb.
Limestone chips for surface-treatment cover	1,010.6 tons	32.2 lb.
Coarse sand for surface-treatment cover	300.2 tons	9.6 lb.
Retread asphalt for shoulders, gal.	6,368	0.557
Surface-treatment asphalt, gal.	15,616	0.248
Screenings complete in place on shoulders	$1,033.99	0.090
Retread asphalt applied and manipulated	$ 616.25	0.054
Completed retread shoulders, 2 in. thick	$1,650.24	0.144
Surface treatment complete, 22 ft. wide	$4,869.83	0.077

Rolling began at once and traffic followed close behind the sand application so that at no time was one-way traffic necessary over any considerable distance.

After the resurfacing had been completed, local public opinion assigned a 50 per cent improvement in riding qualities. By roughometer test the surface now showed 100 half-inches of variation per mile, an improvement of 140 half-inches or 58 per cent. Figure 4 indicates the typical appearance of the completed work. After some 8 months of usage, the retread shoulders appear to be of such stability that 80 to 90 per cent of this very cheap pavement widening will remain serviceable and the remainder can be reconditioned with a moderate repair cost. A cost table is included for the entire described work.

As a result of the experiment the practicability of widening narrow pavements by a retread surface on adequate base was satisfactorily demonstrated, requiring only the application of the usual rules of approved practice with modified equipment. In retrospect, the writer is confidently certain that by increasing the asphalt-surface-treatment oil quantities 50 per cent and using an additional 10 lb. of chips per square yard, the results in further surface smoothing would have increased more than proportionately.

Repeated dragging prior to the application of the sand should have been beneficial also, but this manipulation would have been difficult under existing traffic conditions without reverberating criticism. It would further appear in this instance that slight increased cost by reason of use of materials, methods or devices to minimize delays to traffic and to eliminate petty injury to passing cars is many times repaid in the evidenced satisfaction of the traveling public.

Standards of Highway Width

"Standards of width," observes the 7th biennial report of the California Division of Highways, "are open to improvement in some respects. It seems probable that 20-ft. standard graded width for secondary or mountain roads will have to yield to a 14-ft. standard for all such roads in the near future.

"A grade 36 ft. wide offers parking space for vehicles which must park off the highway, but such widths of grade do not lend themselves at once to the construction of additional width of paving. Possibly a grade 30 or 32 ft. wide may prove more economical and equally useful, especially where grading is heavy.

"Rock borders of bituminous construction adjacent to standard 20-ft. pavements add to the safety of highway travel but do not increase carrying capacity."

Application of Soil Science to Highway Engineering

What is being done in Michigan in the way of subgrade design to solve the problems arising from frost heaves, frost boils and settlements

By VICTOR R. BURTON

Deputy State Highway Commissioner, Lansing, Mich.

FOR a long time engineers have had the knowledge that something is seriously wrong with the design of rigid pavements, because it is pretty generally recognized that traffic plays only a minor part in the destruction of many well-built pavements. Now, as has been brought out before, about 50 per cent of the failures of Michigan's pavements is due to frost and about 30 per cent is due to settlement. Some of this settlement comes after thawing in the spring when we have a supersaturated soil with practically no supporting value. About five years ago when we started our pavement-condition and soil surveys, it appeared to us even then that, while we did not have the exact figures, the two most serious problems with which we should concern ourselves were first, the problem of freezing—frost heaving—frost boils; and, secondly, the problem of settlement.

Settlement of Peat by Jetting.—The problem of settlement in peat marshes was one which was decidedly more spectacular and one which could be much more easily attacked and required less knowledge on the part of the men in the department to find out what to do than in the case of frost heaves and frost boils, so that problem was approached first and we feel quite successfully solved, especially in view of recent developments concerning a new method of accelerating settlement. Standard methods of obtaining or accelerating settlement have always involved dynamiting when the fill meets undue resistance and fails to displace the peat satisfactorily under its own weight. The objection to this method is that in many instances the peat is compacted rather than displaced by blasting and later subsequent settlement may occur as the peat gradually takes up water. The new method involves jetting of the highly compressed peat beneath the fill, thereby introducing water

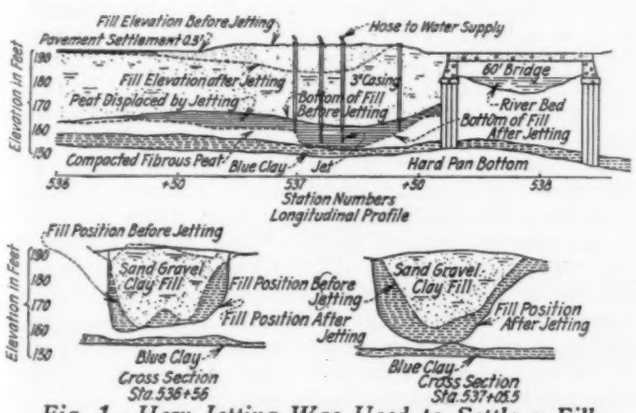


Fig. 1—How Jetting Was Used to Settle a Fill near a Bridge Structure

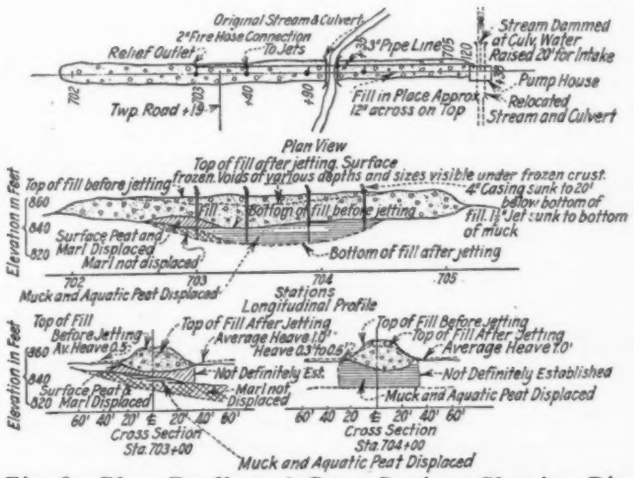

Original Stream & Culvert
2" Fire Hose Connection To Jets
Relief Outlet
3" Pipe Line
Stream Dammed at Culv. Water Raised 20' for Intake
Pump House
Relocated Stream and Culvert
Twp. Road
Fill in Place Approx 12' across on Top
Plan View
Top of fill after jetting Surface frozen. Voids of various depths and sizes visible under frozen crust.
Top of fill before jetting
4" Casing sunk to 20' below bottom of muck
Fill
Bottom of fill before jetting
Fill. 12" Jet sunk to bottom of muck
Surface Peat and Marl Displaced
Marl not displaced
Bottom of fill after jetting
Elevation in Feet
860
840
820
702
703
704
705
Muck and Aquatic Peat Displaced
Stations
Longitudinal Profile
Top of Fill Before Jetting
Av. Heave 0.5'
Top of Fill After Jetting
Average Heave 1.0'
Heave 0.5' to 0.8'
Top of Fill Before Jetting
Top of Fill After Jetting
Average Heave 1.0'
Not Definitely Est.
Marl not displaced
Not Definitely Established
Surface Peat & Marl Displaced
Muck and Aquatic Peat Displaced
60' 40' 20' ℄ 20' 40' 60'
Cross Section Sta. 703+00
60' 40' 20' ℄ 20' 40' 60'
Cross Section Sta. 704+00
Muck and Aquatic Peat Displaced

Fig. 2—Plan, Profile and Cross-Sections Showing Displacement of Peat by Jetting Where Other Methods Had Failed

and creating a tendency for the material to flow under the superimposed load. This method has been used at several locations with very encouraging results.

One particular advantage which jetting appears to have over dynamiting is that the jets can be lowered to any desired position beneath or alongside of the fill. In situations, for example, where the marsh bottom slopes rapidly across the roadway, the jets can be set on the upper side only and thereby accentuate settlement without the invariable loss of fill material down the slope away from the road line. The possibilities of obtaining positive results with this method appear excellent, although, of course, considerable experimentation and investigation will be necessary before it can be standardized.

Figure 1 shows a location where it was not possible to settle the fill by blasting because of a bridge structure resting on piling in the marsh. The pressure of the fill alone against the piling had produced a very slight movement of the structure and it was therefore necessary to resort to a method whereby settlement would be effected gradually and without a shifting of the fill laterally. The jetting operations were finally discontinued for fear that the bridge might be damaged before complete displacement of the peat was effected. It will be observed, however, that almost complete penetration was obtained near Sta. 537.

Figure 2 shows another location where jetting was resorted to after other methods had failed. It will be observed that complete displacement of the peat was effected with this new method.

The Frost-Heaving Problem.—The problem of frost

heaving was one which required a great deal more study and was considerably more difficult. At that time we were not equipped with a cold room and we had no means of going ahead until we had built a laboratory where we could work, so that problem had to wait. But we do feel that we have in the last two years made substantial progress in finding out what causes frost heaving and frost boils and we are now in a position to say what should be done in order to correct these two conditions.

It has been the opinion that frost heaving could not be corrected by tile drainage because the phenomenon is purely capillary in nature, and to a certain extent this is true. Many serious heaves, however, have occurred in Michigan in fine to fairly coarse sands to which water is fed under a hydrostatic head by springs or in which water is held up in the frost area by an impervious layer of soil below. Such heaves can be prevented by a proper and intelligent design of tile drainage. On the other hand, heaves which occur in silts and in some clays are the result of a capillary phenomenon and cannot be corrected by tile drainage. The matter of treatment of the frost boil on our non-rigid surfaces presents a somewhat different problem. The use of tile drainage may not prevent the upheaval but when water is liberated during thaws it is carried away by the drains and the condition alleviated.

In our road design we have up to a comparatively recent period paid very little attention to the soils with which we deal on construction, with the exception of the very worst soil, peat. We did recognize that this type of material should be either excavated or displaced laterally by a mineral soil fill. Other soils of different textures have been handled with practically no regard to the type of soil existing in our cuts and little attempt has been made in the disposition of these materials to use them to the best advantage and to produce a subgrade which is as nearly uniform as it can be made, thereby reducing the tendency toward cracking. Now, it is not so much a question of the material itself as a question of an abrupt change between a finer and coarser material. The finer material necessarily draws water from the coarser material through capillarity and that is true throughout the whole range of soil textures; clay draws moisture from silt and the silt draws moisture from sand. So we can actually produce frost heaving in fills if we encounter silt or extremely fine sand in a cut and take no account of where the material is disposed of in the fill.

When Frost-Action Trouble Occurs.—Our field studies have indicated definitely that trouble from frost action invariably occurs wherever silty or very fine sandy silt textures prevail. As the laboratory investigations to date have not revealed a method of treatment to prevent heaving in these materials, they are actually removed from the grade on new construction work. A few other states are also removing such textures and in some cases are using an imported material for backfilling. Now, in Michigan, we do not feel that this is necessary. A number of serious heaves on important trunk lines have been corrected simply by removing the undesirable textures and backfilling with a sandy loam obtained from the cut in question above the level of the heave material. During the past winter one could actually see an upheaval of the shoulders on either side of the pavement at these locations while the road surface itself remained in its true position. On new pavements built during 1930 a great number of silt deposits were removed and backfilled with sandy materials obtained close at hand and without an exception heaving was eliminated. So it is possible to prevent excessive frost disturbances by removing the source of the trouble and by not necessarily backfilling with an imported sand or gravelly material.

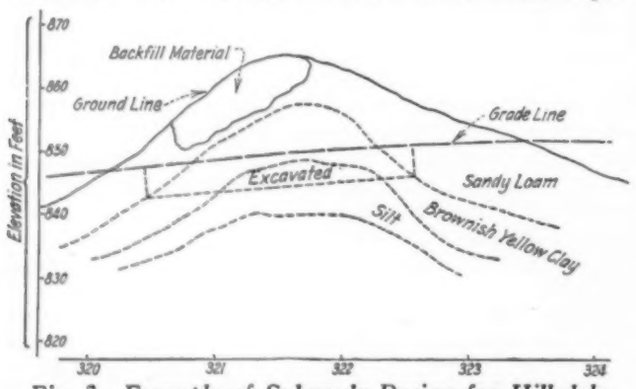


Fig. 3—Example of Subgrade Design for Hillsdale Sandy Loam

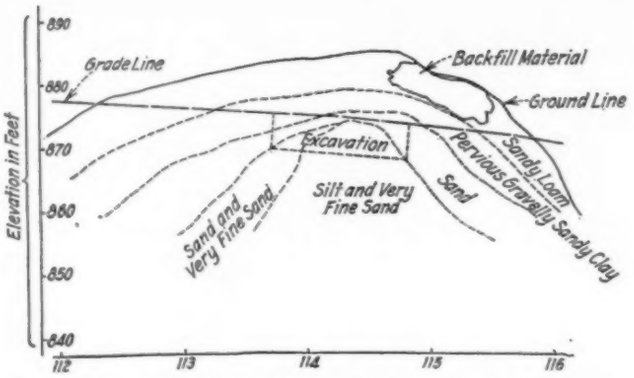


Fig. 4—Example of Subgrade Design Showing Excavation of Frost-Heaving Materials in Bellefontaine Sandy Loam

In order to expedite the application of our knowledge of soils in the construction of new roads it appeared advisable to prepare written instructions for distribution to the road-design and field personnel of the department. These instructions or recommendations list data pertaining to each of the individual soil types existing in the state. There is also included a detailed description of each soil profile. They indicate where the grade line should be established for best results and where questionable deposits of frost-heaving material may be encountered. The order of procedure in our construction work calls for a preliminary soil survey after the line is established. When the plans are drawn the soil types are indicated thereon and it is then possible for the field engineer to locate the various soils and supervise the grading operations in accordance with the recommendations submitted. Then during rough grading or after the rough grading is completed, a second soil inspection is made in order that all deposits of undesirable textures or conditions can be located and properly treated or disposed of.

Examples of Subgrade Design.—Figures 3, 4 and 5 illustrate typical examples of subgrade design. Figure 3 shows a cut in Hillsdale sandy loam where a deposit of silt was encountered slightly below grade and which was excavated to a depth of 3 ft. The surface material in this cut, a sandy loam, was used for backfilling. In this case it was decided also to remove a brownish-yellow clay layer which the grade line intersected on either side of the silt pocket and thereby obtain a perfectly uniform subgrade throughout the entire cut.

In Fig. 4 a somewhat similar example of design is shown. In this cut through Bellefontaine sandy loam

a pocket of very fine sand and silt was removed and likewise replaced with the surface sandy loam material. In these two cases it was not necessary to provide special drainage for the backfill material because pervious soils existed on either side.

Figure 5 is typical of many locations where special design measures are necessary to insure proper drainage of the subgrade. It seemed advisable in this case first to level-off the outcropping clay layer so that no pockets of undrained sand existed within the limits of frost penetration and then to tap the sand layer above the clay barrier with a line of 6-in. tile. When this was accomplished the water table dropped and the cut became perfectly dry.

The point is emphasized again in connection with such grade-design work that it is rarely necessary to use imported material for back filling. In our state it is usually only a question of excavating the undesirable textures and of backfilling with about the same kind of material which exists on either side and above the deposit in question. If this is done during the progress of grading the only cost involved is that of excavation.

Methods of Producing Satisfactory Subgrade.—There are a number of ways in which to produce a satisfactory subgrade. Figure 6 shows three alternate methods of ballasting with sandy or other porous materials. The upper cross-section shows a ballast or thick sub-base which extends out to the ditch lines and is the proper design to use providing there is a possibility of future widening of the road surface beyond 20 ft. The middle section shows a ballasting over a 25-ft. width for a 20-ft. roadway. Here, of course, it is necessary to use tile edge drains to insure drainage for the ballast. The lower section is one which has been used and differs from the center section only in that the tile drains are laid directly on the bottom of the excavation.

Comparison of Costs.—A comparison of the relative cost values per station indicated in Fig. 6 for these alternative methods of ballasting the road bed is interesting. For a depth of ballast of 18 in. the cost is the greater in case of the 25-ft.-width excavation and 3-ft.-depth edge drains. For a ballast of 24 in. the cost is about the same for the full-width excavation and the 25-ft. width and 3-ft. edge drains. As the thickness of the ballasting increases, however, the cost of the full-width excavation increases much more rapidly proportionally than in the case of the other two alternative methods.

The thickness of such ballasting depends, of course, upon the particular case in question and the nature of the material used. This method of treatment is being used in Michigan in those soils which consist of a variable thickness of sand over impervious clay particularly when the grade line is established fairly close to the clay line. Generally in the work which has been done the depth of excavation has been such as to remove all sand pockets, within the limits of frost penetration, that may exist where the clay material sags or dips. There has been some question in connection with this work concerning the properties as an insulating medium of different soil materials. An investigation is being planned to determine in the laboratory what materials—sand, gravel or sandy loams—are the most effective as insulators, and when this information is available it will be possible to design the roadbed intelligently in any section of the state.

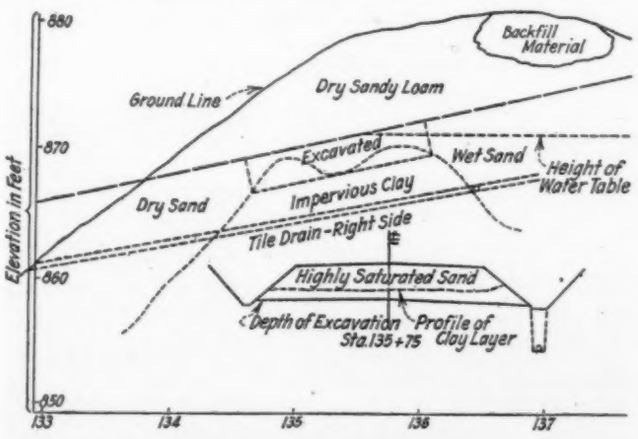


Fig. 5—Example of Subgrade Design in Bronson Sandy Loam

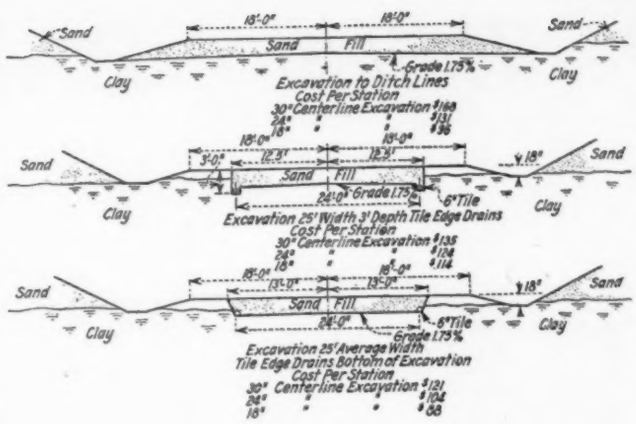


Fig. 6—Alternative Methods of Subgrade Design for Elimination of Frost Heaving and Comparative Costs

Several soils in Michigan, including Miami, Conover and Napanee, of morainic origin, have caused an unusual amount of pavement cracking and breakage. This is particularly true in cuts where the surface is laid directly upon the unweathered subsoil. It is known that much of this trouble is due to frost action occurring as a result of abrupt variations in texture which prevail in this unweathered zone. Serious consideration is being given to the possibility of ballasting the roadbed with a more suitable material whenever cuts are made into these soils. It is believed that the cost involved in doing this would be fully justified especially since our pavement-condition studies have indicated consistently that increased thickness of concrete has not materially reduced cracking and breakage under such circumstances. It is felt therefore that the time has come when more money should be expended on the subgrade. Not only will conditions which cause trouble be corrected but it represents the only form of permanent road improvement. In Michigan it is firmly believed that an expenditure of from $2,000 to $3,000 per mile on the subgrade will return large dividends on the investment in the form of better service and longer life of improvement.

Acknowledgment.—The foregoing is a paper presented Feb. 19 at the 17th annual Conference on Highway Engineering at the University of Michigan.

OILING ROAD SHOULDERS.—In oiling shoulders on California state highways, granite soils, if adjacent to narrow pavements, are mixed to a 3 or 4-in. depth for a width of 3 to 6 ft., 1½ to 2 gal. of 60-70 fuel oil per sq. yd. being necessary. Clays and loams are more susceptible to surface treatment, and the same grade of oil is applied at the rate of ½ to ¾ gal. per sq. yd. This treatment requires renewal in proportion to the use the shoulder sustains.

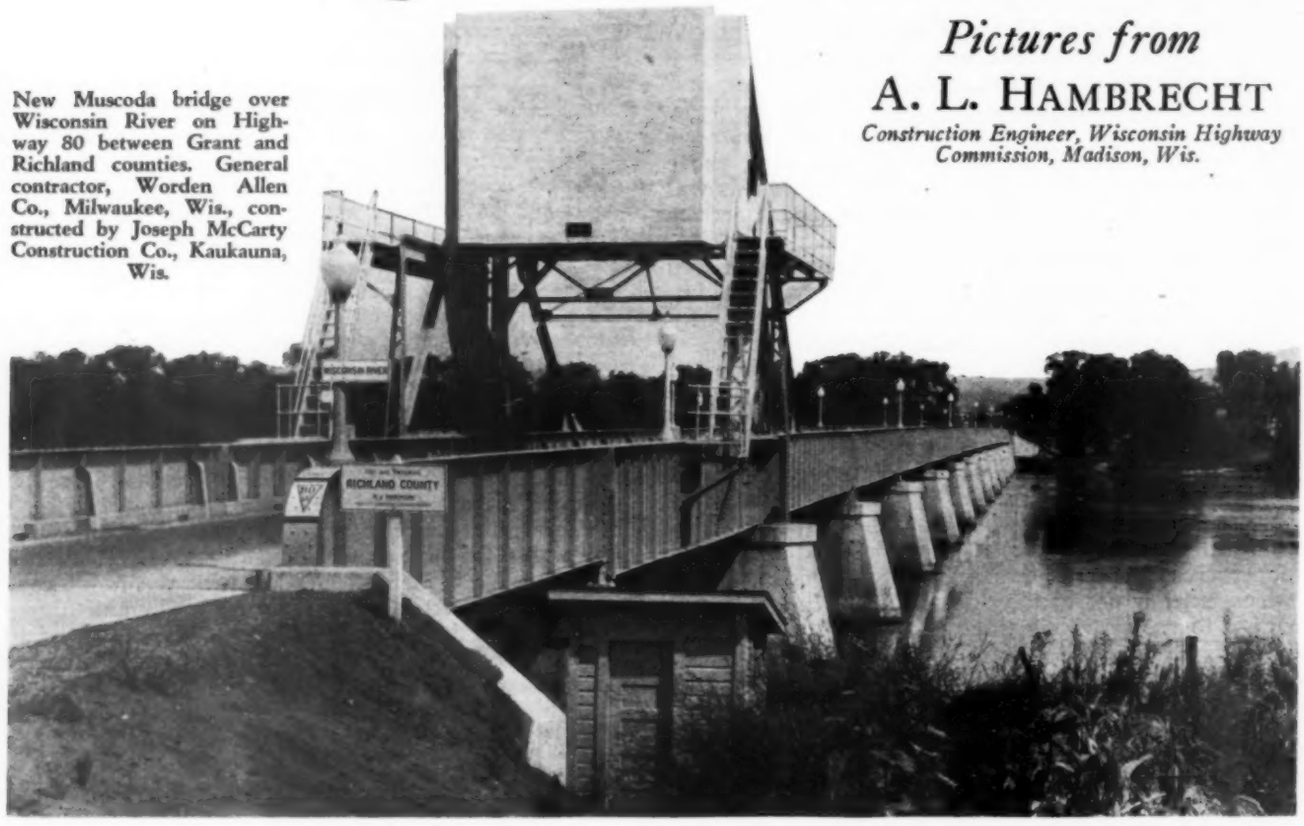
Building BADGER *Roads*

Pictures from

A. L. HAMBRECHT

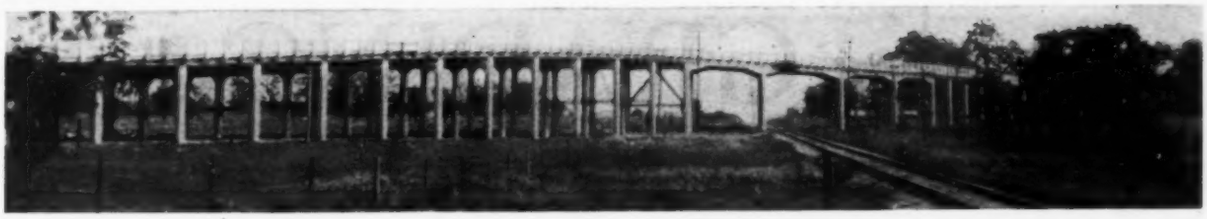
Construction Engineer, Wisconsin Highway Commission, Madison, Wis.

New Muscoda bridge over Wisconsin River on Highway 80 between Grant and Richland counties. General contractor, Worden Allen Co., Milwaukee, Wis., constructed by Joseph McCarty Construction Co., Kaukauna, Wis.



Left—Excavating unstable soil through peat marsh and backfilling with gravelly clay to stabilize roadbed. Maximum Depth of Excavation 8 ft. U. S. Highway 41 in Oconto County. Schuster Construction Co., Denmark, Wis., contractor. Right—Limestone quarry in Grant County. Material used for crushed-rock surfacing on U. S. Highway 18. F. J. Balmer, Waterloo, Wis., contractor.

Left—Local pit of Streu Construction Co. in Sheboygan County, producing separated sizes of coarse aggregate for concrete paving job. Right—Highway 35 in Pepin County. Contractor, Balmat Construction Co., Clear Lake, Iowa. The rugged topography is typical of the land adjoining the Mississippi River, which appears at the left.



Overhead carrying Highway 20 across tracks of C. M. St. P. & P. R. R. in Racine County. Railroad portion is a continuous girder. General contractor, Kramp Construction Co., Berlin, Wis.; subcontractor, Kroening Construction Co., Milwaukee, Wis.

Relocation of Madison-Stoughton road, U. S. Highway 51, in Dane County. Surface is a 20-ft. concrete pavement. Contractor, Kramp Construction Co., Berlin, Wis.

Approach to new bridge over Mississippi River between Houlton, Wis., and Stillwater, Minn. Note heavy cut. Contractor, C. F. Sculley Equipment Co., St. Paul, Minn.

Asphaltic concrete construction on U. S. Highway 2 in Florence County by J. Rasmussen & Sons Co., Oshkosh, Wis. Section consists of gravel base, treated with bitumen, 2-in. asphaltic binder course and 1-in. asphaltic concrete wearing course. Note finishing machine.

Old and new Bridgeport bridges over Wisconsin River on U. S Highway 18 between Grant and Crawford counties. Contractor, Stevens Bros., St. Paul, Minn.

Low-Cost GRADING *on* Oklahoma Highways

Filling Old Roadway Ditch with Earth Excavated by Blade Grader

By C. N. CONNER
Associate Editor

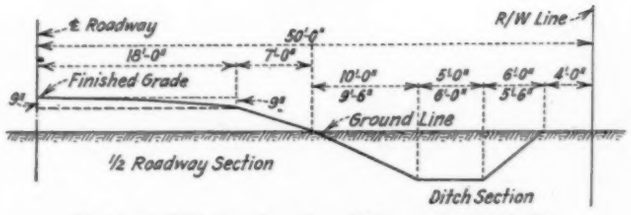
THE cost of grading varies with the amount and character of the material moved and the distance or difficulties of moving it from cut or borrow pit to embankment. Excavation costs are minimum when smallest quantities of earth are moved shortest distances. Full advantage of these facts have been taken by the Oklahoma State Highway Commission in planning and grading state-aid project No. 699, which is the westerly 23 miles in Texas County.

Specifications and Prices.—The state law requires that the highway commission advertise sections in lengths of not over 8 miles. The proposal for this work was prepared for three 8-mile sections and prices were taken on each section and on the total 23 miles. The work was awarded on the quantities, items and unit-prices in Table I to the Yancey Construction Co. for the three sections as one project.

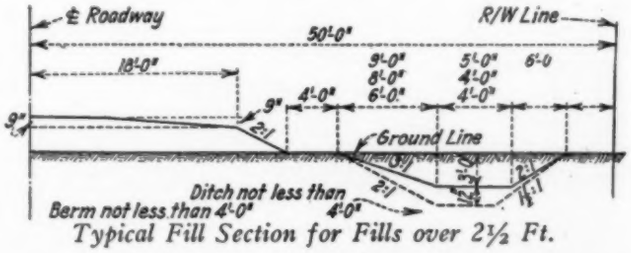
In Table I, "casting and blading" means that material excavated from the side ditches is to be used in constructing the embankment in the same 100-ft. station. Material taken from ditches and moved to construct the embankment in another station is drifted material.

Typical Section.—The typical cross-section is designed to utilize blade graders and elevating graders. The embankment and ditch sections have long, flat slopes and the fill has a width of 50 ft. at the base with a 36-ft. width at the crown. This section is used for fills up to 2½ ft. in height; above that a 2:1 side slope is used and berm of 4 ft. between toe of fill and ditch section.

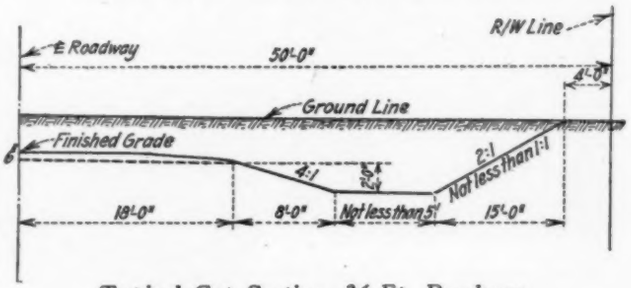
Construction Conditions.—The engineer, during construction, gave the contractor center-line and depth-of-



Typical Fill Section for Fills under 2½ Ft.



Typical Fill Section for Fills over 2½ Ft.



Typical Cut Section, 36-Ft. Roadway

TABLE I—QUANTITIES, ITEMS AND UNIT-PRICES

Sections A, B and C, 23 Miles

Approximate Quantity, Cu. Yd.	Item and Unit-Prices Bid	Amount
159,500	"Cast and bladed" excavation including all clearing and grubbing, removal of structures, obstructions, etc.; formation of embankments and shoulders, as provided in specifications, at $0.09 per cu. yd.	$14,355.00
39,000	Class A excavation, including all clearing and grubbing, removal of structures, obstructions, etc.; formation of embankments, subgrade and shoulders; refilling around all structures, disposal of surplus material and all incidental work, at $0.15 per cu. yd.	5,850.00
1,000	Class C excavation, including all clearing and grubbing, the removal of structures, obstructions, etc.; formation of embankments, subgrades and shoulders; refilling around all structures, disposal of surplus material and all incidental work, at $1.50 per cu. yd.	1,500.00
24,500	Borrow, complete in place, including furnishing, placing, labor, tools, equipment, etc., and work incidental thereto, at $0.12 per cu. yd.	2,940.00
20,900	Excavated material hauled for each 100 ft. beyond the free-haul limit of 300 ft. as specified in Section 17 (except noting, the free-haul is 300 ft. instead of 500 ft.), at $0.03 per cu. yd.	627.00

ditch figures, measuring from a line of hubs set on the right-of-way line.

Payment was made according to ditch excavation measurement; and where the ditch excavation made more embankment or less embankment than anticipated it was leveled off on a grade parallel to the original assumed grade line. The adjusted grade varied only 0.1 or 0.2 ft. from the assumed grade line, and saved a great deal of work in finishing; variation in the different soils and their moisture content might have caused a change as great as this.

The estimated quantities were totaled in the specifications for each 8-mile section and the engineer was required to lay the grade line so that the contract prices would not be exceeded. In flat country the field engineers have been able to do this and over-runs have been avoided.

It is necessary to have sufficient quantities in the original estimate; but large amounts of money are not involved because a variation of several thousand yards

Backsloping with Grader; Men Are Standing on Shoulder Line

per mile can be justified when the time and expense of making a more accurate survey are considered. On this particular contract $90 per mile is the price for casting and blading 1,000 cu. yd. at $0.09. This method of preparing plans is not recommended except in a level or slightly rolling country where these typical sections can be used economically.

Contractor's Equipment.—The contractor's equipment for doing this work consisted of two units; each unit had two elevating graders, or one elevating grader worked 24 hours a day. The ditches of the old road were filled ahead of the elevating grader by the blade grader, and the road was put under construction 1 mile at a time. The finishing and leveling were done with a big tractor and blader; backslopes were cut with graders and the material was used for finishing, with fresnoes as auxiliary equipment. The contractor moved camp for each 6 miles of completed road. The state took over the road in 3-mile sections and released the contractor from further maintenance. Progress and workmanship were reported by the state engineer as good.

Outfit No. 1 consisted of the following equipment:

1 Russell 42-in. elevating grader with 19-ft. carrier
1 Adams elevating grader with 21-ft. carrier and auxiliary power unit
2 Russell 12-ft. blade graders

Casting Cut Material with Elevating Grader

2 Caterpillar 60 tractors
1 Caterpillar 30 tractor
1 Monarch 75 tractor
1 Killefer rooter
13 Watson and Russell dump wagons
80 Head horses and mules
Fresnoes, plows, camp equipment, etc.

On this outfit, two 3-ft. wings on the Russell 12-ft. blade were used for blading surface. One 12-ft. blade was used for tearing down banks and filling ditches ahead of the elevating grader. The Caterpillar 30 and the Killefer rooter were used for making dirt for fresnoes where borrow was required. On this outfit the Monarch 75 tractor and the Adams elevating grader, equipped with electric lights, were worked at night opening up new work, which was finished during the daytime.

Outfit No. 2 was made up as follows:

2 Russell 42-in. elevating graders with 19-ft. carriers
1 Russell 12-ft. blade grader
1 Adams 12-ft. blade grader
1 Adams 10-ft. blade grader
3 Caterpillar 60 tractors
1 Caterpillar 30 tractor
15 Russell dump wagons
125 Head horses and mules
Fresnoes, plows, camp equipment, etc.

Low-cost grading on this project was possible because the engineer designed the roadway cross-section for construction with fast-working modern equipment and permitted reasonable tolerance in the finished grade lines.

Seattle Bridge Paved with Steel Pavement

As the result of a trial installation on the University Ave. bridge in Seattle, Wash., a steel-mesh riveted pavement was chosen for the double-leaf bascule bridge at W. Spokane St.

This steel pavement consists of a series of straight bars, 1¼x3/16 in., riveted together with alternating reticuline or crimped bars, 1¼x3/16 in., forming an open-mesh mat. This is fabricated in sections and by means of a uniquely designed interlocking splice is assembled in the field to form a continuous pavement over the entire area as desired. This splice is so designed that when complete a uniform pavement is stated to be secured, every foot of which is a complete floor.

Figure 1 shows the start of installing the steel pavement, indicating how the sections are readily attached together in the field.

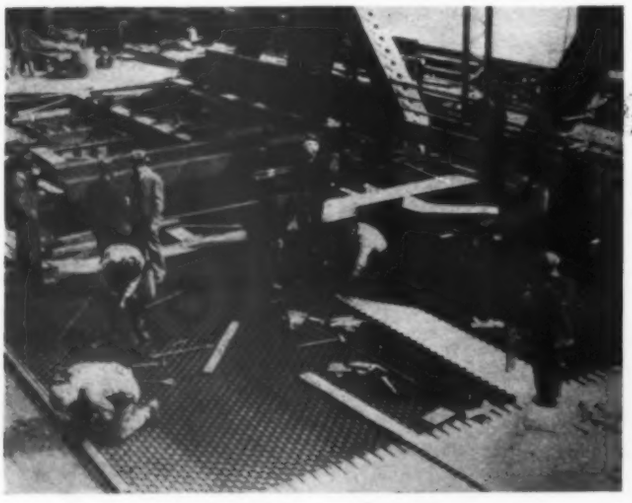


Fig. 1—Installing the Steel Pavement

Fig. 2—Completed Steel Pavement

This pavement was fastened through clips by means of 5/16x3-in. drive screws driven into the creosoted wood deck through a layer of galvanized sheet iron which was introduced to protect the asphalt from any possible chemical action from the creosote.

Figure 2 shows the completed steel pavement. This pavement was filled with sheet asphalt. The asphalt was spread and rolled, after which a heavy truck loaded with sand and equipped with wide solid rubber tires was run back and forth while the fill was still warm, thus giving slight cupping in the meshes.

This installation was made under the specifications of the city engineering department and under the direct supervision of the bridge department of the city of Seattle, Wash. It was installed by the General Construction Company, Seattle, Wash., and made by Irving Iron Works Co., Long Island City, N. Y., of which Walter E. Irving is president and P. L. Price, chief engineer.

Annual Meetings of A. R. B. A.

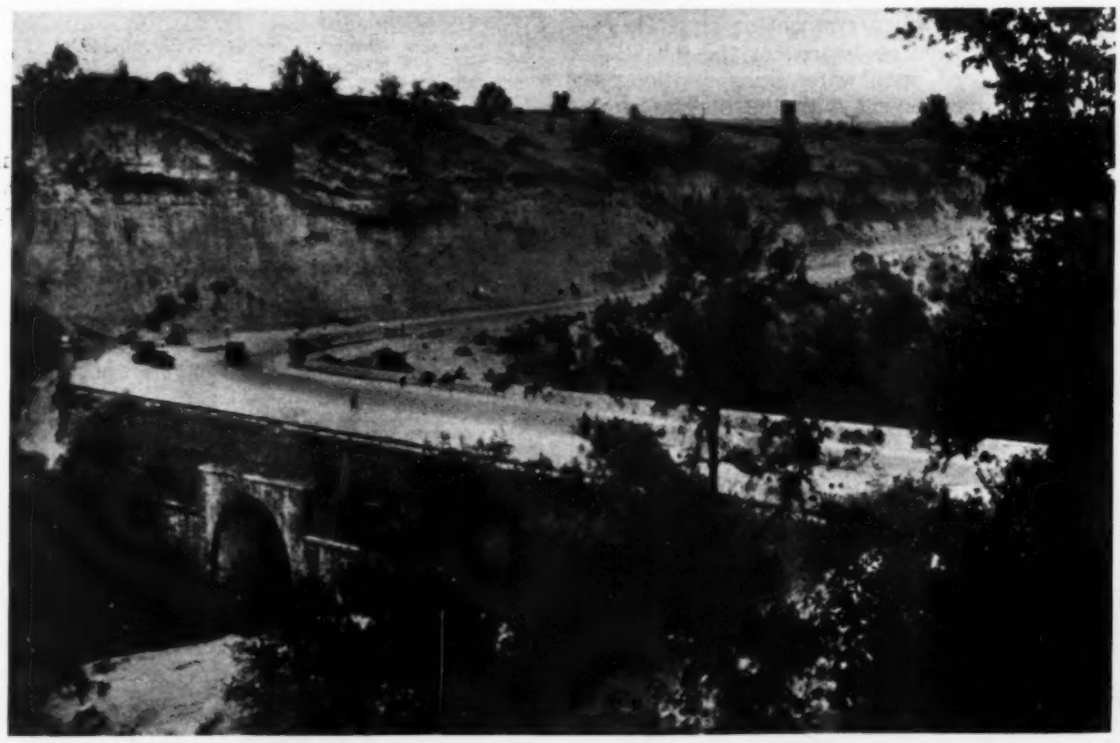
The regular annual meeting of the American Road Builders' Association will be held Friday, May 15, at 3:00 p. m., at the offices of the association, 938 National Press Building, Washington, D. C. The officers and directors elected at the recent convention in St. Louis will be installed at this meeting and the reports of the board of directors and of the officers whose terms expire at this meeting will be received, and such other business transacted as may be deemed necessary. The annual dinner honoring the retiring president of the association will be held Friday evening, May 15, at the Willard Hotel.

The regular annual meeting of the City Officials' Division will be held Saturday morning, May 16, at 11 o'clock, at the offices of the association. The newly-elected officers and directors of the division will be installed at this meeting and the reports of the board of directors and of the officers of the division whose terms expire at this meeting will be received, and such other business transacted as will be found necessary.

The regular annual meeting of the County Highway Officials' Division will also be held Saturday morning, May 16, at 11 o'clock, at the offices of the association.

Two Mexican Bridges

An Ancient Bridge over the Lerma River on the Mexico-Guadalajara Highway (International Pacific Route) near Toluca. This Bridge Is Typical of Spanish Construction



Emperor's Bridge on the Mexico-Puebla Section of the Pan-American Highway. This Bridge Was Constructed by the Unfortunate Maximilian (Emperor of Mexico 1864-67) and Is Still in Use

Dune and Beach Sands

Sand Asphalt Highway in the Coastal Region of North Carolina

Combined *in Sand Asphalt* Job

SOME unusual construction features are involved in a sand asphalt project now being constructed in North Carolina. An interesting account of this work was given by W. E. Hawkins, Construction Engineer, State Highway Department of North Carolina, in a paper presented at the 9th Annual Asphalt Paving Conference.

The project is situated on a narrow peninsula of land which borders on the Atlantic Ocean, and is separated from the mainland by large bodies of water, known as sounds. The road is being constructed as a connection btween the mainland and Roanoke Island, on which is located Maneo, the seat of government of Dare County.

In the past it has been necessary for the inhabitants of the island to depend upon water transportation as a means of trading and contact with the outside world. Privately-owned boat lines and ferries were operated on established routes. In the past several years the roads on the island were improved, and a bridge was constructed between the island and the peninsula. The public sentiment aroused by these improvements caused an agitation for the building of a road that would serve as an outlet to the mainland. The only feasible location for this road was through an isolated, barren section adjacent to the ocean coast, as sandy as the Sahara Desert.

An interesting phenomenon in this section is the manner in which particles of sand from the ocean shores are carried by the winds of high velocity, and deposited in dunes of great height, covering acres of ground.

Sand Grading.—Realizing that the amount of funds available for the building of a road in this isolated section would necessitate the utilization of local material, a number of tests were made of local sand to determine if sand asphalt construction were feasible. The average results of the grading of the dune sand were as follows:

Retained on	Per Cent
40-mesh sieve	2.70
80-mesh sieve	64.60
200-mesh sieve	32.70
Passing 200-mesh	0.00

Tests were made of other deposits of sand, of which there were many varieties. It was found that the material located on the ocean beach near the high-water mark averaged in grading as follows:

Retained on	Per Cent
10-mesh sieve	2.00
40-mesh sieve	49.80
80-mesh sieve	36.20
200-mesh sieve	12.00
Passing 200-mesh	0.00

When these sands were combined in the proper proportions they produced a mixture that would meet the grading requirements for a sand asphalt pavement.

Equipment and Material Shipped in by Barge.—After this preliminary investigation, the project 10.7 miles in length was advertised, and in April, 1930, was awarded to the R. G. Lassiter Co., of Raleigh, N. C.

All of the equipment used in the building of this project was shipped by rail, then transferred to barge and transported by water to a pier at Nags Head, Roanoke Sound, constructed especially for this work. The shipments of asphalt, made in drums, and filler dust in paper sacks were transported by barge, unloaded at the pier and hauled by truck to the work.

Striking-Off with Finishing Machine

The plant was located adjacent to the road, about 4½ miles from the beginning of the project, at the base of a large sand dune. The gas crane, equipped with clamshell bucket, was so placed

on an elevation that excavating into the sand dune was accomplished with little trouble. The coarse sand was hauled from the ocean beach and deposited within reach of the gas crane.

Kink for Hauling over Deep Sand. — When this work was first considered the problem of hauling caused some apprehension. This was overcome by the use of 1½-ton Ford trucks, equipped with dual tires. By inflating the tires to about one-half the required pressure, the trucks transported a 2-ton load over the deep sand with little difficulty.

Portion of Finished Highway; Contractor's Outfit at Work in Distance

In the preparation of the base mix, the sand was combined 1 part beach to 4 parts dune, and 7½ per cent asphalt. The wearing-surface mix was composed of 1 part beach to 3 parts dune sand, 10½ per cent asphalt and 7½ per cent filler dust.

During extremely hot weather some difficulty was experienced in rolling both courses. The hot mix, when placed on the sand subgrade, would transmit the heat to the sand, and when an attempt was made to roll, the mix would be displaced and distorted. It was necessary to wait until night before rolling could be completed. Similar trouble was experienced in rolling the surface course, but during the autumn months the change in temperature allowed rolling to be completed several hours after the last material had been placed.

The results of sand asphalt have been so satisfactory on this project, that public sentiment is demanding an extension that will complete the road on the peninsula.

Contractors Reimbursed for Extra Pavement Thickness

During the period ended Dec. 1, 1930, the Bureau of Material of the Missouri State Highway Department made core tests of all pavements constructed during the period. The cores were taken primarily for the application of the specification under which contractors are penalized for constructing a pavement of less than the specified thickness or reimbursed for any contractor-furnished materials used in extra thickness of pavement, and also for obtaining a definite knowledge of the quality of the concrete manufactured.

The provisions of the pavement thickness specifications were made a little more stringent for projects let and constructed in 1930 by increasing the minimum thickness for acceptance to ½ in. less than the thickness specified on the plans. Heretofore the minimum thickness for acceptance wos 0.9 in. less than the specified thickness.

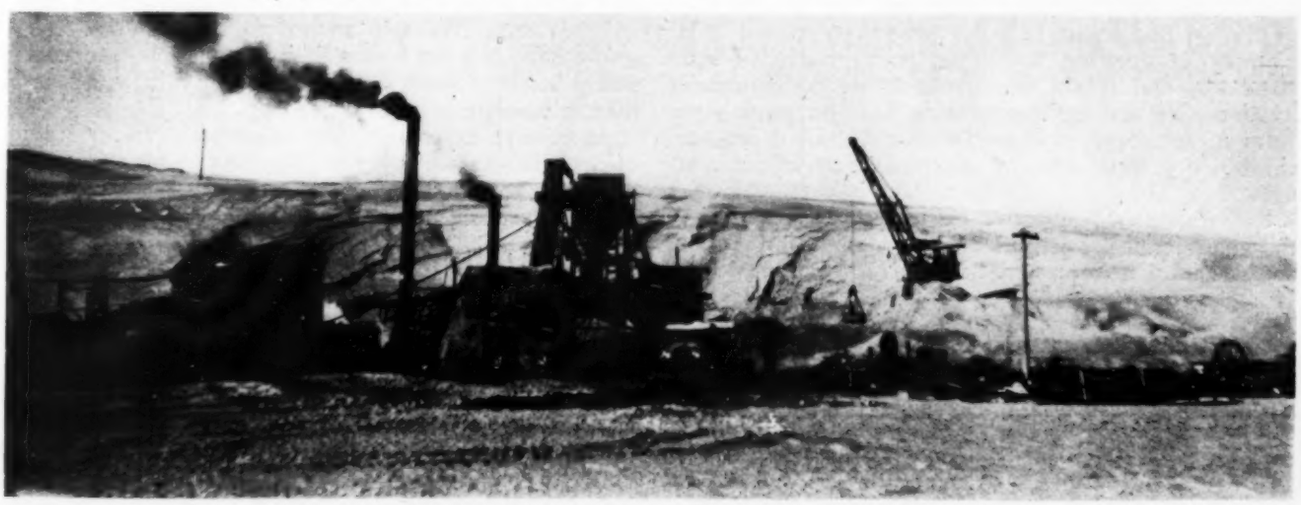
The length of the sections considered was shortened from 1 mile to 1,000 ft. This change prevents the possibility of constructing short sections of pavement of extra thickness to compensate for thin pavement, and avoiding a deduction thereby.

According to the 7th biennial report of the state highway commission, a very consistent gain in thickness is noted for projects closed out during the successive years since the inauguration and use of the pavement thickness specifications. The progressive gain is shown in the following tabulation:

Projects closed out 1927	+0.0780 in. extra thickness
Projects closed out 1928	+0.2666 in. extra thickness
Projects closed out 1929	+0.3155 in. extra thickness
Projects closed out 1930	+0.3350 in. extra thickness

The projects from which the 0.078 in. extra thickness was obtained were drilled merely for information regarding the variations in thickness and average thickness of projects constructed without the pavement thickness specification being applicable.

Thickness variations have decreased considerably in magnitude during the four years tabulated above. Particularly have the variations below the specified thickness decreased; that is, cores are still obtained which measure 7.5 in. and 8.0 in., but few measure less than 5.5 in.



Asphalt Mixing Plant; Crane in Background Is Obtaining Fine Sand from Dune

Applying Cut-Back Asphalt

Mixed-in-Place Construction *on a Texas State Highway*

By JOHN E. BLAIR

Division Engineer, Texas State Highway Department

THE Texas Highway Department has been experimenting for the past year or two with gravel surfaces treated with bituminous materials by the mixed-in-place process. In the work so far done the procedure followed has been, in general, that developed in certain of the western states, and given publicity through the various periodicals devoted to highway affairs. The project here described differs in some particulars from the majority of the work I have seen described in print, and some of the observations made may prove to be of general interest.

The section of highway selected for this experiment is part of State Highway 6 in Robertson County, from Calvert northward toward Bremond, and at the date of this writing about 12 miles have been treated. The highway in question has never been graded to state standards, and is not considered to be on permanent location. Soil and traffic conditions, however, made some form of temporary surface imperative, and it was decided to try some kind of inexpensive asphaltic treatment.

Soil Conditions.—On the greater part of the section, the natural soil consists of fine sand, mixed with more or less dirt and loam, underlaid by red sand clay. The sand clay consists in general of about 80 per cent sand and 20 per cent clay. In both the sandy top soil and the sand clay underneath, small gravel is found. In the course of years the constant blading of the ditches, throwing the excavated material on to the road, together with the action of rain, wind and traffic, has served to accumulate a considerable quantity of small gravel and coarse sand in the subgrade, giving the road the appearance of having been surfaced with gravel. The gravel was practically without binder, and was always badly corrugated, both when wet and when dry. In dry weather the dust nuisance was very annoying.

The subsoil is very stable and, except for the corrugating mentioned, holds up satisfactorily either wet or dry under loads of almost any size. In view of this very stable subgrade it was decided to try surfacing it with about 3 in. of mixed-in-place material, depending on the subgrade and natural soil to carry the loads without building a gravel base.

Binder Material.—In deciding on the material to be used for the binder it was necessary to take into account the fact that we had no steam boilers for heating tank cars, no pump for handling asphalt from cars to trucks and no pressure distributor for applying asphalt at a uniform rate. We also wished to use material which would have as great final stability as possible, and which would attain a high degree of stability in as short a time as possible.

After some experiments conducted with various grades of cut-back asphalt, using small quantities which we purchased in barrels, we fixed on a light grade of Texaco cut-back asphalt, meeting the following requirements:

1. It shall be free from water or decomposition products.
2. It shall not flash below 80 deg. F. when tested by the Cleveland open-cup tester.
3. The specific viscosity (Engler) at 77 deg. F. (25 deg. C.) 50 c.c. shall be not less than 50 nor more than 70.
4. When distilled by A.S.T.M. method D-20-28T with base of bulb of thermometer not over ½ in. from bottom of flask, the distillate off by volume shall be as follows:

   Off at 437 deg. F.....not less than 15 per cent
   Off at 600 deg. F.....not less than 30 per cent
   Off at 680 deg. F.....not more than 43 per cent

5. When poured from the flask without cooling immediately upon reaching the maximum temperature specified, the residue shall have the following characteristics:

6. The penetration at 77 deg. F., 100 g., 5 seconds shall be not less than 80 nor more than 110.
7. It shall be soluble in chemically pure carbon disulphide to the extent of at least 99.0 per cent.
8. The ductility at 77 deg. F. 5 cm. per minute shall be not less than 100 cm.

Preparatory Treatment.—Before proceeding with the treatment of the road surface enough material was added to the surface to compensate for any spots where the gravel content of the soil did not seem to be up to the average. Local deposits were available from which gravel which contained a large percentage of coarse sand could be secured. Enough of this material was added to make the surface material all as near alike as possible. In general from 1 to 2 in. of this new material was added, and was incorporated in the loose surface of the road by blading. After adding the new material a typical screen-analysis of a sample taken from the road surface was about as follows:

Retained on ¼-in. screen	35 per cent
Passing ¼-in. screen, retained on 10-mesh	41 per cent
Passing 10-mesh, retained on 20-mesh	10 per cent
Passing 20-mesh, retained on 50-mesh	8 per cent
Passing 50-mesh	6 per cent

Applying Asphalt.—The cut-back asphalt used was quite fluid at ordinary temperatures and, inasmuch as this work was done in July and August, when the weather in Texas is very hot and dry, we expected to be able to pump the asphalt direct from tank cars to tank trucks with an ordinary centrifugal pump without heating. This proved to be correct and the cars were unloaded without difficulty with a small centrifugal pump (2-in. connections) belted to a gasoline engine which we had mounted on an old truck chassis for convenience in moving.

For distributing the asphalt ordinary water tanks mounted on trucks were used. These trucks were the same we customarily use for hauling water for sprinkling gravel or stone bases, and were equipped with a perforated pipe for sprinkling the water or oil on the road. One or more trucks were used, depending on the distance being hauled, the tanks varying in capacity from 500 to 1,000 gal.

Before distributing any asphalt a scarifier was run over the road to loosen up any hard spots. We attempted to have the surface loosened to a depth of about 3 in., which was about the depth of the treatment we proposed to make. The depth actually secured varied somewhat, being probably a little less rather than more.

To secure uniform distribution of the asphalt we concluded that we would make a large number of very light applications, and trust to the blading to secure a uniform mixture. The trucks were therefore driven at a fairly rapid rate, so that a load of about 500 gal. would cover a distance of about a mile, about 7 ft. wide. Immediately after the first truck had passed, the graders began blading the loose gravel. In order to compensate for the fact that the asphalt ran out of the truck faster at the start, when the tank was full, than toward the end of the run, when the tank was practically empty, the trucks were started alternately first at one end of the section and then at the other, so that the part which was thinly sprinkled by the first truck would be thickly sprinkled by the next, and vice versa. This worked out very well in practise. There was also some overlapping of loads from one section to another, as no effort was made to keep the sections separate. This all produced a very close approximation to uniform distribution.

Unloading Asphalt from Tank Car to Truck by Means of Small Centrifugal Pump Belted to Gasoline Engine Mounted on Truck Chassis

Based on using 1½ gal. per sq. yd. 20 ft. wide, 17,600 gal. would be required on a mile of road, and if a 500-gal. tank were emptied on a mile, then it will be seen that 30 to 35 trips over the same mile would be made. We kept no record of the exact amount of asphalt used on each mile, going principally by the appearance of the mixture to tell when enough had been applied, but this is about the way it worked out in actual practice.

Mixing.—Because of the very hot, dry weather the asphalt had a tendency to set up before it could be properly mixed, and the method we followed of trying to handle the entire roll of loose material at once with the blade also tended to prevent proper mixing. We are now of the opinion, after considerable study and experiment, that better results can be secured by first opening up a subgrade with the heavy grader, pushing out to the shoulders enough loose material to make a depth over the road of about 2 in. The subgrade would then be treated with successive light applications of asphalt, and the mixing carried on as before. As the material in the subgrade became mixed and began to consolidate the blade would be used to pull in from the roll on the shoulders a little

Bladers at Work after Application of Asphalt, Mixing Bituminous Material with Loose Gravel in Road

gravel at a time, and the oiling and mixing would proceed from the bottom up. We believe this would result in better mixing and greater final stability, as well as in permitting the use of lighter graders for the mixing operation. The graders could also be run at higher speed. As another item, on a road where it is necessary to maintain traffic, as in this case, a heavy roll of loose earth and gravel is a serious obstruction to traffic, whereas a lighter roll would be much less objectionable.

Because of the somewhat unsatisfactory results secured in the mixing, as stated above, we have had considerable trouble due to raveling of the completed surface in spots, resulting in a large number of small surface pits, from 3 to 6 in. in diameter, and from 1 to 3 in. deep. To overcome this condition we have adopted the following procedure.

Overcoming Raveling.—All holes that are large enough to be particularly objectionable are first patched with a mixture of the same material as used on the road, mixed either by hand or in a small portable concrete mixer. These patches compact readily, and are scarcely to be distinguished from the rest of the surface in 24 hours. The surface of the road is then covered with the gravel and coarse sand scattered by hand from the tail of a truck at the rate of about 1 cu. yd. to 150 sq. yd. The 0.1 to 0.25 gal. of 65 per cent asphaltic road oil, hauled from another job some 10 miles away, and the road is given a heavy blading. Since the new oil softens the surface of the cut-back asphalt very slightly, a very little of the old surface below is shaved off and incorporated with the new mulch on top. A very satisfactory bond is thus obtained and, owing to the fact that the oil hardens much less rapidly than the cut-back asphalt, the surface can be bladed for several days.

The surface, although only a little more than 2 in. thick, is quite stable, carrying wheel loads of 5,000 lb. or more at speeds of better than 30 m.p.h. without sign of distress. No shoving or settling under traffic has been noted, and it is our opinion that the surface is now stable enough to be surfaced with a seal coat of hot asphalt, and to do its full duty as a paved road.

Costs.—A total of 152,529 sq. yd. of surface has been treated, the asphalt used being 308,861 gal., or about 2 gal. per sq. yd. In keeping costs, the labor payroll is added to the cost of asphalt used, and to the cost of equipment rental, which in the Texas Highway Department is fixed at a rate sufficient to take care of all operating cost plus repairs and depreciation. The cost so arrived at is as follows:

Asphalt, 308,861 gal. at $0.0756 per gal. on cars at job	$23,349.89
Hauling and distributing asphalt, at $0.0035 per gal.	1,068.88
Mixing and maintaining surface, at $0.028 sq. yd.	4,212.23
Supervision and various contingencies	1,776.23
Total	$30,407.23

This shows the cost for the asphaltic treatment alone to be $0.199 per sq. yd. The cost of any gravel added should be added to this amount, this item, of course, varying with local conditions. In this case additional gravel amounting to 7,169 cu. yd. was added, costing $10,594.00, or $0.07 per sq. yd.

An additional cost is now being incurred on this project, as explained above, due to smoothing up the surface with additional sand and oil. This cost has not yet been determined, but will be about as follows:

Gravel, 1 cu. yd. to 150 sq. yd. at $1.50	$0.01
Road oil, ¼ gal. per sq. yd. at $0.05 per gal. applied	0.0125
Additional blading	0.005
Total	$0.0275

The total cost of the project, including additional gravel placed, is therefore about $0.2965 per sq. yd. It will be necessary next summer to put a seal coat of hot asphalt on this road at a cost of about $0.10 per sq. yd.

The work above described was carried out by state forces under this writer as division engineer and Ed Bluestein as assistant directly in charge on the job.

Aerial Reconnaissance in Highway Surveys

Aeriel reconnaissance and surveys were an interesting part of the location work of the New Mexico Highway Department last year. G. C. Lassetter, engineer of surveys, summarizes this work as follows in the January *New Mexico Highway Journal:*

The first reconnaissance by air was from Santa Fe to Aztec, a distance of about 175 miles over rough mountains and broken country most of the way. The entire trip was made in less than five hours at a cost of $100.

A study of the country from Frijoles to Jemez Springs was made from the air to determine the most feasible route through the Valle Grande and the best mountain pass to the east without making preliminary ground surveys. This trip was made at a cost of $50 and it is estimated that about 15 miles of preliminary location was saved.

A very interesting study of drainage was made of the federal-aid project between Alcade and Velarde. The idea of this study was to determine the approximate length and size of the larger drainage areas without actually running them out on the ground. This work was done in an hour's time at a cost of $30 with very satisfactory results. It would have taken one man at least two weeks to run these areas on the ground or to get the information needed.

Aerial reconnaissance from Laguna by Acoma, Inscription Rock and Ramah to Zuni and St. Johns was made to determine the feasibility of building a road through this route or possibly putting it on the federal system. Because of lack of trails and the poor condition of those that exist, it would have taken several weeks to make an intelligent investigation in any other way. This work was done in five hours' flying time at a cost of $125.

A very interesting piece of aerial work was made on Dec. 22, in the form of a map, to scale, made from photographs of the three highways coming into Shiprock Indian Agency. These highways come in from three distinct directions, one from the north, one from the east and one from the southwest. Besides the Indian agency, the San Juan River must be considered in any highway location at this point. The main object of this map and survey is to try to settle a disagreement between the Indian agency, the Bureau of Public Roads and the state on rights-of-way. If possible, it is the state's desire to save the expense of building an unsatisfactory layout around the Indian agency and possibly a new bridge across the San Juan River. It took about six hours' flying time to make the picture for this map at a cost of $250. It is hard to determine the economical value of aerial work connected with location. Besides the time saved, it gives a much better study of the country on preliminary investigation before an actual location is made than can be obtained in any other way. Often a mountain pass or open easy country can be located from the air which would be acceptable as a route between control points that one might fail to find in any amount of study from the ground.

Uniform Street Sanitation Records, Cost Standards, Installed in Brunswick, Ga.

THE first complete installation of the records and cost accounting proposals of the Committee on Uniform Street Sanitation Records has just been made in Brunswick, Ga. During three weeks of residence in Brunswick, the staff, consisting of Donald C. Stone and G. A. Moe, not only installed the standard work units proposed by the committee, but also set up unit-cost standards for each activity and prepared a work program for the current year. A complete description is now being made of the Brunswick installation which, together with all forms employed, will be distributed to 800 other cities in the country with populations of 10,000 to 50,000 inhabitants.

Although the Committee on Uniform Street Sanitation Records represents primarily the International Association of Public Works Officials (formerly the International Association of Street Sanitation Officials), other national organizations engaged in this field are represented on an advisory committee, namely: the National Committee on Municipal Standards, the International City Managers' Association, the American Society of Municipal Engineers, the Governmental Research Association, the American Society of Civil Engineers, the American Municipal Association, the American Road Builders' Association, the National Municipal League and the American Public Health Association. Joseph J. Petranek is chairman of this committee. The work is financed and staffed by the International City Managers' Association through funds made available by the University of Chicago and the Julius Rosenwald Fund.

Brunswick was selected by the committee as a model city for demonstration purposes after an extensive survey of cities in the 15,000 population class. This honor was accorded to Brunswick because that city is performing all types of activities including street cleaning; the removal of garbage, trash, night-soil and dead animals; incineration, dumping, catch-basin cleaning and other services included in the committee's program and usually supplied only in larger cities. Moreover, the methods employed by City Manager E. C. Garvin in administering these activities, together with his budget system, are of such excellence that an installation of the committee's system could be made with relative ease.

The installation consisted of introducing the following:

1. Daily field reports for all work performed and equipment used.

2. Equipment records showing the performance and costs of operating each piece of equipment.

3. Cost records by means of which the daily field reports, equipment records and other accounting forms can be compiled into total and unit-costs of the work done.

4. A complaint procedure insuring that every complaint will be investigated with dispatch.

5. Monthly statements of work and costs, of man-hour production, of services performed and of complaints; showing in each case how accomplishment compares with a predetermined standard. (See Fig. 2 and 3.)

Standard Work Units Employed.—The system installed in Brunswick employed the work units which the Committee on Uniform Street Sanitation Records has established for standard use throughout the country. The work units tested in this installation are as follows:

1. Street Cleaning: the "cleaning-mile"; that is, a mile of street cleaned once by beat patrol and machine sweeping, which are the only methods employed. The same unit is also applicable to broom gang, machine flushing and hose cleaning.

2. Street Sweepings Removal: (a) "cubic yards of sweepings removed," and (b) "cubic yards removed per cleaning-mile."

3. Catch-Basin Cleaning: (a) "cubic yards of cleanings removed," and (b) "number of catch basins cleaned."

4. Garbage and Trash Removal: "cubic yards removed." "Tons removed" is a supplementary unit when weights can be made of each load.

5. Night-Soil Removal: "cubic yards removed."

6. Dead Animals Removed: "number of animals" of the following classification: dogs, cats, chickens, goats, hogs and cattle.

7. Refuse Disposal: "cubic yards" and "tons" as in removal.

Work Program and Unit-Cost Standards.—A work program for the entire year was prepared for each of the above activities. (See Fig. 1.) This work program shows the total work for each operation to be done during the year expressed in terms of work units, unit-cost standards and total cost. The amount of work to be done was based on an analysis of the present schedule of operations and the estimates of the city manager and street and sanitation superintendents. Schedules of sizes of routes and frequency of work therefore support Fig. 1.

The unit-cost standards represent

Brunswick, Ga. SCHEDULE A - WORK PROGRAM FOR 1931

Operations (1)	Standard Units Employed (2)	Total No. Work Units (3)	Unit Cost Standard (4)	Total Cost (5)	January (6) No. Work Units	January (6) Cost	February (7) No. Work Units	February (7) Cost	March (8) No. Work Units	March (8) Cost	April (9) No. Work Units	April (9) Cost	May (10) No. Work Units	May (10) Cost
1. Refuse Removal	Cu. Yd.	55,000	$0.30	$16,500	4,500	$1,350	4,000	$1,200	4,200	$1,260	4,800	$1,440	5,000	$1,500
Night-Soil 2. Removal	" "	1,335	1.50	2,002	125	187	110	165	100	150	125	188	125	188
3. Incineration	" "	10,600	0.15	1,590	900	135	800	120	900	135	1,800	150	900	135
4. Dumping	" "	45,535	0.04	1,829	3,725	149	3,310	132	3,400	136	3,925	157	4,225	169
Machine 5. Sweeping	Cleaning-Mile	1,105	1.00	1,105	110	110	100	100	100	100	100	100	100	100
6. Beat Patrol Sweepings	"	2,880	0.40	1,152	240	96	240	96	240	96	240	96	240	96
7. Removal Catch-Basin	Cu. Yd.	940	0.15	141	100	15	100	15	100	15	90	13	90	12
8. Cleaning	" "	400	1.00	400							200	200		

	June (11) No. Work Units	June (11) Cost	July (12) No. Work Units	July (12) Cost	August (13) No. Work Units	August (13) Cost	September (14) No. Work Units	September (14) Cost	October (15) No. Work Units	October (15) Cost	November (16) No. Work Units	November (16) Cost	December (17) No. Work Units	December (17) Cost		
1. Refuse Removal Night-Soil	4,500	$1,350	5,500	$1,650	5,000	1,500	4,000	$1,200	5,000	$1,500	4,000	$1,200	4,500	$1,350		
2. Removal	100	150	125	187	100	150	100	150	100	150	100	150	125	187		
3. Incineration	900	135	900	135	900	135	800	120	900	135	800	120	900	135		
4. Dumping Machine	3,700	148	4,725	189	4,200	168	3,300	132	4,200	168	3,300	132	3,725	149		
5. Sweeping	85	85	85	85	85	85	85	85	85	85	85	85	85	85		
6. Beat Patrol Sweepings	240	96	240	96	240	96	240	96	240	96	240	96	240	96		
7. Removal Catch-Basin	80	12	70	10	70	10	60	9	80	9	60	9	60	9		
8. Cleaning			100	100					100	100						

Fig. 1

the minimum unit-cost at which Brunswick may be expected to perform its work. Thus, they may serve the officials of Brunswick as a standard throughout the entire year to guide them in evaluating actual performance. It was necessary to post all of the records from Jan. 1 to the time of the installation in order to set up these unit-cost standards. The total costs on the work program were then computed by multiplying the unit-cost standard by the amount of work to be done. Ordinarily many of the unit-cost standards should vary from month to month but the system must operate a year or two before such refinements can be attained.

During the course of the year, a monthly work and cost statement will indicate whether the work program is being complied with and the extent to which actual unit-costs conform to the unit-cost standards. (See Fig. 2.) This monthly statement provides the city manager and the street sanitation officials with a control over each of the operations listed. If the work or unit-costs do not conform to the estimates and standards, the detailed cost records are analyzed to determine the cause therefor. The schedules of work or methods can then be revised on the basis of the facts provided by this installation.

Control Over Complaints and Special Services.—To improve the method of handling citizens' complaints and requests for special services, a new complaint record was installed. This record provides the name and address of the complainant and spaces for checking the type of complaint or the type of special service. These captions are also listed on Fig. 3. The form is printed in duplicate, the first copy being given to the investigator and the second remaining in the office as a control. If it is a citizen's complaint, the investigator will state in detail in the space provided, who was at fault and the action taken.

ANALYSIS OF COMPLAINTS AND SPECIAL REQUESTS FOR SERVICE

City of Brunswick, Ga. For month of_____ 193____

Sanitary Department

NATURE OF COMPLAINT	RESULTS OF INVESTIGATION
1. Failure to collect refuse	Justified Complaints
2. Careless or unsanitary handling . . .	1. Collector failed to stop . . . . .
3. Discourteous acts by collector . . .	2. Refuse not properly removed . . . . .
4. Personal property taken by collector	3. Collector discourteous . . . . .
5. Other	4. Collector took property not on refuse pile
TOTAL	5. Other justified causes . . . . .
	TOTAL . . . . .
SPECIAL COLLECTIONS REQUESTED	Unjustified Complaints
1. Garbage	6. Refuse improperly placed . . . . .
2. Trash	7. False complaint. . . . .
3. Ashes	8. Property carelessly left on refuse pile
4. Dead Animals	9. Proved to be request for special collection
5. Other	10. Other unjustified causes . . . . .
TOTAL	Total unjustified complaints . . . . .
	Total complaint investigations . . . . .

Comparison of Complaints	This Month	Last Month	This Year	Last Year
Justified				
Unjustified				
Total				

Fig. 3

At the end of the month, these complaint reports will be compiled and entered on the Analysis of Complaints and Special Requests for Service. (See Fig. 3.) This analysis not only separates the special services from actual complaints but shows the cause of complaints and whether they are justified. With this analysis at hand, the officials will have a barometer of citizen satisfaction with their work and will be able to identify the causes of complaints.

After completing the Brunswick installation and remaining until every phase of it was tested the staff stopped at Charlotte, N. C., at the request of R. W. Rigsby, city manager, and A. B. Cook, sanitary superintendent. Although time did not permit the committee's system to be installed while the staff was there, all of the forms and instructions necessary for the installation were prepared.

The next complete installations will be made in Kenosha, Wis., and Troy, N. Y. The staff expects to complete these by the end of May. The installation cities in the population classes of 150,000 and 500,000 will be selected later. Any inquiries concerning this work should be directed to the committee at 923 E. 60th St., Chicago, Ill.

COMPARATIVE WORK AND COST STATEMENT for STREET AND SANITATION DEPARTMENTS for month ending 193

City of Brunswick, Ga.

Operation (1)	Work Units (2)	Units of Work Done			Unit-Cost			Total Cost		
		Actual Work (3)	Work-Program Estimate (4)	Difference (5)	Actual (6)	Unit Cost Standard (7)	Difference (8)	Actual (9)	Work-Program Estimate (10)	Difference (11)
Sanitary Department										
Refuse Removal	Cu. Yd.									
Night-Soil Removal	" "									
Incineration	" "									
Dump Disposal	" "									
Sanitary Department Totals										
Streets and Drains										
Machine Sweeping	Cleaning-Miles									
Beat Patrol	Cleaning-Miles									
Sweepings Removal	Cu. Yd. Cleaning-Miles									
Street Construction and Cleaning	Miles									
Street Grading	Miles									
Street Repairing	Sq. Yd.									
Sewer Work	Lin. Ft. No. Basins									
Catch-Basin Cleaning	Cu. Yd.									
Ditching	Lin. Ft.									
Streets and Drains Totals										

Fig. 2

CONCRETE ROADS IN GREAT BRITAIN.—The British Portland Cement Association states, according to *Roads and Construction* (London), that during 1930 over 296 miles of all-concrete road were laid in Great Britain, thus constituting a record for any one year. This increase is accounted for not only in county and municipal work but also for private street work and estate development. In the case of many newly-developed estates, instead of constructing a temporary road for the use of builders, concrete roads are laid down before building commences. These roads carry the traffic incidental to construction and provide a permanent roadway for residents from the outset.

EDITORIALS

The Improbability of a Correct Inference from False Premises

IT is generally conceded that the only test of a scientific theory is that inferences deduced from it agree substantially with observed facts. Yet, by a curious twist, it has recently come about that the soundness of the ether theory is seriously questioned by several eminent scientists, in spite of the admitted correctness of many a scientific law based on the postulate that there is an ether that transfits radiant waves. Either it is not true that the test of a theory is its agreement with facts, or the eminent scientists have erred in rejecting the ether theory.

If agreement with facts is not the ultimate test of any theory, what test is there? Prediction that is verified by the subsequent occurrence of the predicted event? Well, that is only a special case of an agreement of a theory with a fact. Verified prediction has been called the most rigid test of a theory, and it is the very test that Einstein requested astronomers to make when he predicted that light rays passing near the sun would be deflected a certain amount. Yet Einstein is now counted among the physicists that doubt the existence of ether, in spite of the fact that the ether theory has also been proved true by the test of verified prediction, not only once but many times.

The problem in logic that we submit to our readers is this: May a scientist apply a certain sort of test of truth to his own theory and deny to another scientist the right to apply the same sort of test to some other theory?

It seems to us to be almost self-evident that a scientific theory can be proved to be true only in one way, namely by showing that deductions from it agree so closely with facts not used in framing the theory that it is improbable that the observed degree of agreement would occur by accident. Jevons and other logicians have pointed out that precisely quantitative agreement between theory and observed fact never occurs. Jevons attributes lack of precise agreement partly to the imperfections of measuring instruments and partly to the existence of forces that interfere with the results that the theory leads one to expect. He mentions the failure of plants to travel in "exactly" elliptical paths, and points out that in physical measurements the term "exactly" means only a very close approximation to an assumed or deduced quantity. Since there is no possibility of precise agreement between a quantity deduced by aid of a theory, and a quantity measured by physical instruments, it follows that the rules of mathematical probability should be applied in every case where a theory is tested by an appeal to facts. Were precise quantitative agreement attainable, and were such agreement between theory and fact found, the odds would be infinity to one that the theory was correct. The odds obviously decrease as the divergence increases between a theoretically deduced quantity and the corresponding measured quantity; but it is worthy of note that the odds may still remain heavy in favor of the truth of a theory in spite of a considerable divergence of a measured quantity from the deduced quantity.

It may be argued that true inferences may be deduced from false premises, and that therefore agreement between a deduced result and an observed fact is not a perfectly reliable criterion of the truth of a theory. Such an argument, if valid, wipes out of existence a criterion of scientific truth that has had the support of every great physical scientist from Galileo to Einstein. While it is possible that an erroneous theory may lead to a correct inference, we know of no way in which this can occur except through an error in the process of deduction, such, for example, as an erroneous multiplication. Since an error of this sort is readily discoverable, its existence reaches the vanishing point when several independent experts have checked the processes of deduction. Granted that every expert may commit the same blunder in a given instance, the very rarity of such an occurrence is itself usable in a probability calculation as to the truth of the theory. Without having gathered all the known instances of such errors of deduction that were not immediately discovered by subsequent analysts, we can not state the odds against an error of this sort. We venture to guess that the odds are so many millions to one that for practical purposes we may say that, in any given deduction from scientific theory that has been checked by ten competent experts, there is practical certainty that the deduction is correct. If so, the premises must be substantially correct if the results deduced from them are in substantial accord with facts not used in framing the premises.

The failure of a theory or a law to agree "exactly" with certain facts to which it relates has often been said to discredit the theory. Thus Newton's theory of gravitation errs very slightly in not allowing for any change of mass of a planet due to a change of its orbital velocity; hence not a few scientists have erroneously argued that this discredits Newton's law of gravitation. It should be evident from the foregoing that to make such an inference is equivalent to disclosing lack of understanding of the principle that the truth of a physical theory or law is not absolute but relative. When a friend tells you that it is 10:15 a. m., he is not discredited when you show him that it is 10:15:10; nor would you be discredited if a split-second watch were used to give still greater accuracy in answering the question, "What time is it?"

The Basic Method of Scientific Research

MATHEMATICS and astronomy are the only sciences older than logic. In spite of its age, logicians differ even as to the nature of the two basic forms of reasoning, namely induction and deduction. Three of the most eminent British writers on logic were Mill, Whewell and Jevons. They were never able to come to an agreement as to the fundamental nature of induction and deduction. While all agreed that the inductive process leads to generalizations, they could not agree as to the mental processes involved.

It has long seemed to the editor that their failure to come to an agreement originated in their failure to see that a new generalization is fully established only by the sense-organs. While it is true that they all said that the

truth of a theory can be established only by showing that it accords with facts, they failed to place sufficient emphasis upon the process by which such an accord is found to exist. That process is always one of observation, and observation is but a term that denotes the use of the sense-organs. These three great logicians were so concerned with what may be called the "mental processes" of reasoning that they gave insufficient consideration to the "sensual processes" upon which reasoning is based and by which reasoning is confirmed.

If we regard all reasoning as being expectant memory we shall see that the confirmation of the expectation by observation is the proof—and the only proof—of the soundness of the reasoning.

If a flame is seen, for the first time and the hand attempts to seize it, a burn, with its attendant pain, occurs. At a later time another flame is seen and it is instantly inferred that it will cause pain if touched. Mill, Whewell and Jevons tell us that this is merely reasoning by analogy, and that not until many flames have been investigated without finding a single exception, is the induction framed that: "All flames cause pain when touched by the skin." Then they add that when such an induced generalization has been established by experience and not till then does true deduction occur, expressible in the syllogistic form thus:

1. All flames if touched cause pain.
2. This thing is a flame.
3. Therefore this thing will cause pain if touched.

Here we have (1) the "major premise," (2) the "minor premise" and (3) the deduced conclusion or inference. But even a dog draws precisely the same inference after a single painful contact with a flame. Where, then, shall we draw the line between one experience and many in laying the basis for an inference of this sort? The answer seems to be that only a sufficient number of experiences are required to form a sense-record that persists until the occurrence of another similar event. There is therefore, no way of distinguishing between the three primitive processes that we label (1) analogical reasoning, (2) inductive reasoning and (3) deductive reasoning. They all reduce to one the same thing—expectant memory.

At first it seems incongruous that the discovery of a scientific law can be the result of expectant memory; for how can a man discover only what he remembers? The answer is that Nature endlessly repeats certain phenomena and also repeats the same fundamental "patterns" in phenomena that often seem entirely different. The dog's inherited sense-records suffice to assure him that similar things usually cause similar effects; so a single burn is basis enough for correct inferences thereafter respecting flames. In the case of a research scientist, a reading of the experiences, furnishes the basis for a generalization such as this: No two phenomena are utterly unlike; and guided by a visible likeness, however faint, likenesses as yet unseen are discoverable.

In brief, the slightest analogy furnishes the clue upon which a tentative theory may be framed. A generalization is based on this theory and deductions are drawn from the generalization, whereupon observations are either made or old ones investigated to the correctness of the inference. If this is a true description of the basic process of scientific research, it follows that research is an expectant memory process in which both mind and body cooperate. It starts with an observed likeness, and this involves both memory and the organs of sense. It moves along to the inference that other likenesses exist. It usually seeks to discover at least one other likeness so as to narrow the field to be explored by the organs of sense. It infers from the one or more observed likenesses, that the phenomenon under investigation possesses some other attribute usually found associated therewith.

Scientific research that leads to true inductions of a general nature involves exploration of nature by the sense organs, which exploration is usually the most fruitful when guided by a tentative theory based on some analogy between the phenomenon under investigation and some better known phenomenon.

So far as the brain part of the process of inductive reasoning is concerned it apparently does not differ at all from deductive reasoning. An artificial distinction, however, may be drawn, but the distinction is solely one of degree of probability of the truth of the generalization. The major and minor premises of syllogistic deduction are assumed to be so highly probably as to amount to practical certainty. In that case the truth of the inference is also practically certain. But in the case of an inductive inference, before its truth has been established by the sense organs, there is only some degree (often very small) of probability that its major premise is true. The major premise, which is derived from some analogy, is provisionally assumed to be true, so that an inference may be drawn from it. Then comes the sense-organ process of investigation upon which to base a calculation as to whether the inference is probably correct. We say "then comes," when we should say "then should come." Unfortunately many would-be researchers stop short of testing the truth of their inferences by an appeal to enough facts to permit an application of the principles of mathematical probability.

W. P. Gillette

Danger—Narrow Bridge

PHYSICAL conditions responsible for accidents on highways may always be corrected if funds are available. Referring to a serious collision caused by a narrow bridge, a recent newspaper editorial stated, "Primarily this accident and thousands of others like it in all parts of the country were due in part to engineering stupidity."

For many years, while traffic was relatively slow, engineers have designed rural highway bridges narrower than the highway. To offset this defect in recent years, signs of warning have been erected in some instances, but signs, even when illuminated, are not always effective in preventing serious casualties. Up to 1929 the standard roadway width on bridges and culverts acceptable for federal aid was 18 ft. Since 1929 it has increased to 20 ft. with a trend toward 24 ft. as speed limits continue to grow.

Those states which have been building roads for the greater number of years find that 27 to 30 ft. is not too much for safety on two-lane highways which carry heavy traffic. For new construction, the clear roadway width on a bridge or culvert should be greater than the width of the adjacent highway pavement, and the widening of old narrow structures to safe widths should not be delayed. Narrow bridges are commonly the result of constricted finances and not injudicious engineering.

County and Township Roads

A Section Devoted to the Interests of Those Responsible for Secondary Road Improvement

Gravel Road in Roanoke Township, Ill. Shoulders Have Just Been Rolled

Traffic-Bound Gravel Roads
in an Illinois Township

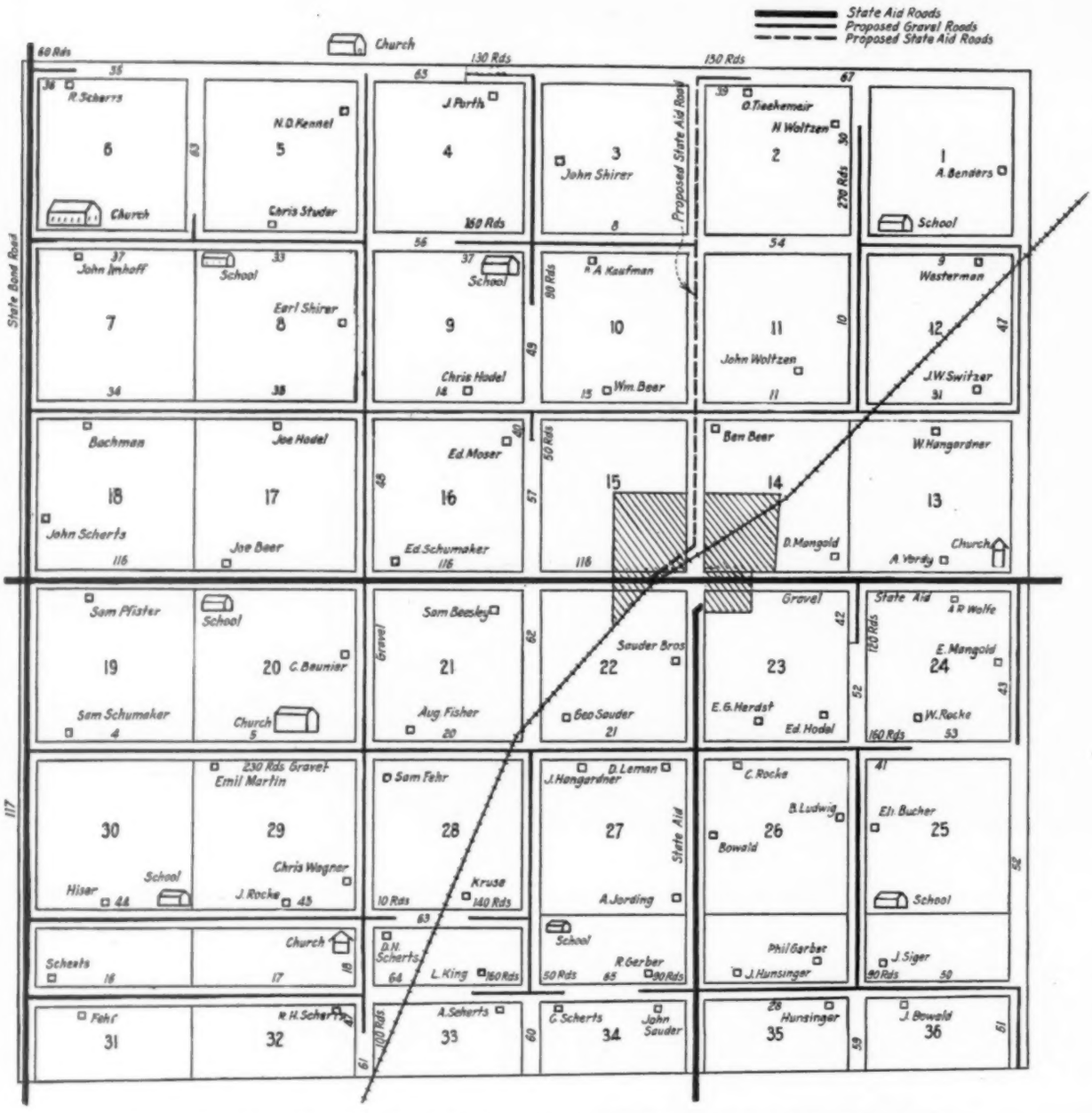
Roanoke Township, in Woodford County, builds 37 miles of traffic-bound washed-gravel roads in one season—Construction result of thorough planning and investigation—Methods and costs of construction

By J. B. GREUTER
Commissioner of Highways

EARLY in the spring of 1930 several farmers became interested in graveling our township roads, and in furthering this idea set a date on which a general meeting would be held to discuss the proposition. The township hall was filled to overflowing on the afternoon of the meeting, and after the appointment of a temporary chairman a general discussion was held. The majority opinion seemed to be that the time was right for putting ourselves out of the mud, so a committee was appointed to go into the matter of costs, location of roads and types of material.

Committee Appointed.—This committee was composed of five men, one from each corner of the township. The chairman lived close to our town and approximately in the center of the township. They soon found that it would require about 35 miles of roads to give everyone an outlet, and from costs of roads built by the county the previous year, estimated that it would require $80,000 to $90,000 for the work. It was found that our limit of bonding at the time was $83,000.

Every Farmhouse on a Gravel Road.—After this preliminary investigation a large map was drawn showing all houses, churches and schoolhouses in the township, and the present pavements and county roads in the township to which we must connect our new system. The town of Roanoke is situated nearly in the center of the township and a county road runs east and west, and another north and south through the town. Part of this is paved



Township Map Showing Road System, along with Houses, Churches and Schools

and the rest will be paved or graded in the near future, and at the time was oiled. There is another county road on our west township line; part of this was already paved and the rest was to be graveled by the county during the year. Reference to this map will show that in some instances we did not propose to build an entire mile but only spurs to give an outlet. In a few instances these spurs caused the farmer to go a short distance out of his way, in that this would be of little inconvenience. When this map was completed so that everyone could see where we proposed to build the new roads, a petition was drawn up asking that a question be submitted at the general election in April of bonding our township for $83,000, the bonds to run for 10 years. Each committeeman took a copy for the signature of his neighbors, and I circulated a copy in town. No trouble was encountered in securing the signatures of the required 100 freeholders, for even the town people felt that it would be of great benefit. At the election the proposition was carried by an overwhelming majority, so grading of the roads was begun at once.

Cost $140 per Mile.—The township had one 5-ton track-type tractor and a 10-ft. grader, and another 50-hp. tractor and a 12-ft. grader was purchased. Both of these were equipped with backslopers. The roads were 50 and a few 60 ft. wide, so that we had plenty of width to build a wide, flat-bottom ditch on both sides of the bed. The windrows were about 15 ft. apart and the filling, but most of the work was done with the graders. In practically all cases the roadbed was 30 ft. from shoulder to shoulder and this surface was left with about a 3-in. crown.

The roads were in good condition before this new grading was begun, but we felt that, once the gravel surface was built, we would not want to do much moving of dirt and accordingly tried to build the ditches and shoulders so that they would stand for a long time. On an average it took the two grading outfits 3½ days to complete a mile. Figuring labor at $5 a day for the 4 men,

Rolling Shoulders of Grade to Improve Drainage and Furnish Smooth Surface for Growth of Sod

or a total of $20; gasoline and oil for the two tractors at $12 a day and depreciation at $8 a day, the total costs were $40 per day. Working 3½ days per mile made the average grading cost $140 per mile.

During the past three years we had installed quite a number of precast concrete culverts at farm entrances, but additional culverts were required at a cost of about $80 a mile on all the 37 miles.

Investigate Types of Roads.—While we were preparing our roads for the gravel, the committee, together with the township officers, made a number of trips into adjoining counties, investigating the various kinds of material being used for such roads as we were going to build. Crushed stone, washed gravel, a clay-binder-type gravel and local gravel were considered. We went into one adjoining county where small-sized washed gravel had been used for years, and found wide, smooth roads in good condition. In talking with the people who built these roads, we found that there was but little more expense required in building under the traffic-bound method, and the committee felt that the added width and the extreme smoothness offset this small expense.

Note Sloping Sides of Flat-Bottom Ditch and Uniformity in Size of Gravel

In looking over the clay-binder gravel roads, the committee did not like the idea of buying and paying freight on the 10 or 20 per cent of dirt which this binder gravel contained. Also it was found that the amount of money we had to spend would buy only enough gravel for a 9-ft. roadbed. Thus if the clay-binder type of gravel were used, we would have only a one-way traffic lane, while with the same amount of washed gravel, using the traffic-bound method of construction, we would secure approximately a 15-ft. roadway. Also our investigations led us to believe that once the clay-binder type of road was packed down it was not very adaptable to maintenance, and we would still have the expense of dragging the dirt roadway on either side of the 9-ft. lane of gravel.

Contract Let in June.—By June 1 we had about 15 miles graded and ready for gravel, and we felt that we would certainly have another 15 miles graded during the summer, so we advertised for bids on June 24 for placing a 6-in. layer of gravel or stone 9 ft. wide on a total of about 30 miles of roads. This was divided into three sections of about 10 miles each.

Wherever Possible, Farmers Were Induced to Gravel Their Own Driveways, Thus Eliminating Carrying of Dirt on to Gravel Roads

On the day of opening bids, 12 contractors submitted bids on various materials, and the committee, together with the township officers and the county superintendent of highways, who had to approve the contract, decided to buy ¾-in. washed gravel meeting the Illinois State Highway Department specification No. 4, Grade 2, which is as follows:

	Per Cent
Passing ¾-in. sieve	100
Passing ½-in. sieve	45 to 75
Passing No. 4 sieve	0 to 25
Passing No. 8 sieve	0 to 10

One section was awarded to a contractor trucking his material about 11 miles from a small washing plant, and the other two sections to a contractor who was shipping his material from a large commercial washing and screening plant at Chillicothe. The gravel cost about $2,150 to the mile, using approximately 900 yd. to the mile.

Build a Mile a Day.—The contractor shipping in Chillicothe gravel started at once unloading about 18 large cars a day, using hopper-bottom cars and a small conveyor under the railroad rails. He used 10 large dump trucks hauling 3 to 4 yd. each, and on an average haul of 4 miles placed nearly a mile of gravel a day. The trucks dumped the gravel into a spreader box, which, as it was pulled forward, spread a 6-in. layer of gravel 9 ft. wide. As soon as a few miles were graveled, one of the township tractors, together with a grader, was used to blade most of the gravel into windrows on each side of the road. The windrows were about 15 ft. apart and the

space between was left with a layer of loose gravel about 1 in. thick. As traffic compacted this gravel, additional layers of the gravel were pulled in from the windrows on to the center of the roadbed. At the present time most of the gravel has been compacted into a solid roadbed about 15 ft. wide, and the frequent dragging with a three-way drag has produced a smooth and slightly crowned roadbed most pleasing to the motorists. During the early days of the building of these roads, after every rain, many of the farmers would drag a mile or two of the roads in front of their houses, and this was a great help in making the road pack down quickly and evenly. On account of the dry summer we were able to complete grading the entire 37 miles by early in September, when the spreading of all of the gravel was completed.

Cost $2,370 per Mile.—The money from the sale of our bonds was allowed to draw interest until it was used in paying estimates and we secured nearly $1,000 added revenue in this way. Our yearly road and bridge fund of $10,000 was used to buy the new tractor and grader and the balance applied to the grading so that altogether we had the $83,000 from bonds, $1,000 from interest and $10,000 from the road and bridge fund for a total of $94,000. Figuring the cost of grading the 37 miles at $140 per mile, or $5,180, additional culverts at $80 per mile, or $2,960, and 37 miles of gravel at $2,150 per mile, or $79,550, our total expense for the 37 miles of washed-gravel, traffic-bound roads was $87,690.

We feel that our maintenance expense will drop down to about one-third of the cost of maintaining the earth roads before we put through our gravel program, and this saving will pay off the bonds in 10 to 15 years.

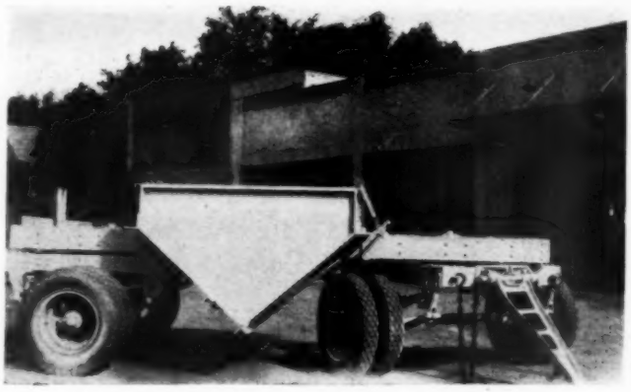
A 4-Yd. Truck Trailer for Spreading Gravel

By A. R. Bailey
County Engineer, Ann Arbor, Mich.

HAULING gravel for resurfacing gravel roads is perhaps the largest single item of cost involved in maintaining such roads. This will be evident from a study of the maintenance costs for almost any year. During 1929 in Washtenaw County the cost of resurfacing work amounted to 43 per cent of the total maintenance cost.

In Washtenaw County it so happens that in the southeastern area, covering nearly five townships, or about one-fourth of the county, there are no gravel deposits. Each year the gravel for both construction and maintenance has been shipped by rail from pits located at a considerable distance and this method naturally resulted in additional handling of the gravel as well as a certain amount of demurrage, which cannot be avoided when many cars are to be unloaded, together with its delay to trucks while waiting for cars and switching. During the year 1928, 434 cars, containing 16,578 cu. yd. were shipped at a cost for freight of $16,192 and with demurrage amounting to $422. This shows that the approximate cost per cubic yard for freight was $1. This depends very much on the way the cars are loaded at the pit.

The conditions named above led to a study of the possibility of using a trailer behind the ordinary gravel dump truck with the idea of making the long hauls with such equipment instead of by rail shipment. Accordingly in the spring of 1929 a box was designed to hold approximately 4 cu. yd., and this was mounted on an old truck chassis equipped with regulation wheels and solid tires. The motor, transmission and other unnecessary parts were removed. The trailer was coupled as closely as possible to the truck without interfering with dumping of the truck itself. Safety chains were, of course, used at all times.



Trailer Constructed by County Road Department For Hauling and Distributing Gravel

Operation of this unit was so satisfactory that early in 1930 a second trailer was constructed but with certain improvements that resulted from a study of the operation of the one during the previous season. An old truck chassis was not used but instead a used standard four-wheel trailer was purchased and all wheels were equipped with dual pneumatic 34x7-in. tires. The platform body was removed and two 8-in. channels weighing 21.25 lb. per ft. were used for the frame, sides and ends. Cross-members were put in to give the requisite stiffness. The side pieces of the frame pass through the box itself, much like the construction of a railroad gondola car. This box, shown in the picture, has a capacity of 4 cu. yd. and will spread the gravel uniformly to any required depth. The opening can be changed to suit the requirements. A trip lever is used very nearly like that used on the regular dump truck and is connected by a rope to the cab of the truck so that both truck and trailer can be dumped without the operator leaving his seat.

The cost of the trailer complete ready for operation, including a two-coat paint job was as follows:

Trailer unit with wheels	$1,041
Materials including channels	114
Eight tires	538
Box assembled ready for mounting	154
Labor assembling and painting	182
Total cost	$2,029

Experience with this unit during 1930 shows that it can be hauled behind the ordinary 4 or 5-yd. dump truck without such truck being delayed in its daily work. The cost of haul per yard-mile for the combined unit is approximately one-half the usual cost for the ordinary 3 or 4-yd. truck. This figure takes into consideration depreciation, overheads and interest on the investment, as well as the regular operating costs. Another interesting thing learned during the past year with these two trailer units working was that both of them on a short haul of 2 or 3 miles could haul about 250 cu. yd. per day. Gravel-pit layouts where truck-and-trailer outfits are used must be planned so that trucks can trail the loading bins in order to avoid backing and turning. Such layouts have been the practice in this county for several years.

A Review of Highway Financing

By NORMAN A. BLANEY

Director, Farm-to-Market Road Department, American Farm Bureau Federation

THE United States is now carrying on a stupendous program of providing the nation with a more adequate highway system. The fact that the program is continuing is sufficient proof that the people of this country are not yet satisfactorily served by highways. More roads are in demand and must be built. Those already constructed must be maintained. The cost of new roads and maintaining those already built must be paid for. There are, in the main, three sources from which funds have been obtained for the purpose of constructing and maintaining state roads: (1) road-user taxes, in which class are included gasoline taxes, motor-vehicle fees and bonds; (2) property taxes and appropriations from general funds and (3) federal aid. In addition to these there is a certain amount of miscellaneous funds and, in some states, county contribution. Considering the country as a whole, the amount received by state highway departments from minor political units is offset by the amount paid to the minor units by states Miscellaneous funds cannot truly be classified as a definite or permanent source.

In connection with county and township roads, two sources exist, the road-user taxes, which again include motor vehicle fees and gasoline taxes, and the second group—bonds, property taxes and appropriations from general funds. A review of the facts in connection with highway financing should be of considerable interest not only to those who must pay the bill, but also to those officials, whether elected or appointed, who have been delegated the responsibility of providing highway facilities for this nation.

Many Proposals Before State Legislature.—Quite a number of questions arise concerning the amount which should be received from these various sources. The majority of the state legislatures which have been in session during the current year have had presented to them proposals which contemplate changes in financing, in construction and maintenance policy and in administration. Each piece of legislation is, at least theoretically, advocating these changes with the desire of providing better facilities and greater equality of cost. We have now and always will have those who are not of the same opinion as the majority. All matters which pertain to economics are debatable. Many of the changes such as have been advanced by the various factions represented in legislatures are divergent to the greatest extremes. There are among them those who claim that all functions of tax expenditures should remain with the county unit; that the policy of "home rule" should be the order of affairs; that any diversion from such a policy is in direct opposition to the constitutional rights of individuals; that any diversion will, in effect, convert the mass into mere servants. There are also represented those who contend, as apparently "big business" contends, that centralized government and centralized expenditure will result in greater economies and are, therefore, to the ultimate advantage of the individual. Arguments may be found in support of each of these extremes. As previously stated, economics is a debatable subject.

The writer is of the opinion that the majority of our officials are honestly endeavoring to enhance and assist in the progress of the people and are not "out" for personal gain.

In any discourse of this type, generalities and averages must be the rule, not the exception. When the matter is totally reviewed, there is every possibility that it will not do more than assert the trend. In its "as is" state it may be of little or no value. The reader will very likely be obliged to review the facts existing in his immediate locality and make certain adjustments if he is to relate general conditions to those existing in his home state or county.

The basis on which theorists and economists lay the foundation of their theories, in all questions of financing governmental activities, is that he who benefits should pay the cost entailed in providing the facilities which benefit him. Whether or not this basis is in actual effect in regard to the providing of more usable roads may or may not be revealed by study of the available facts.

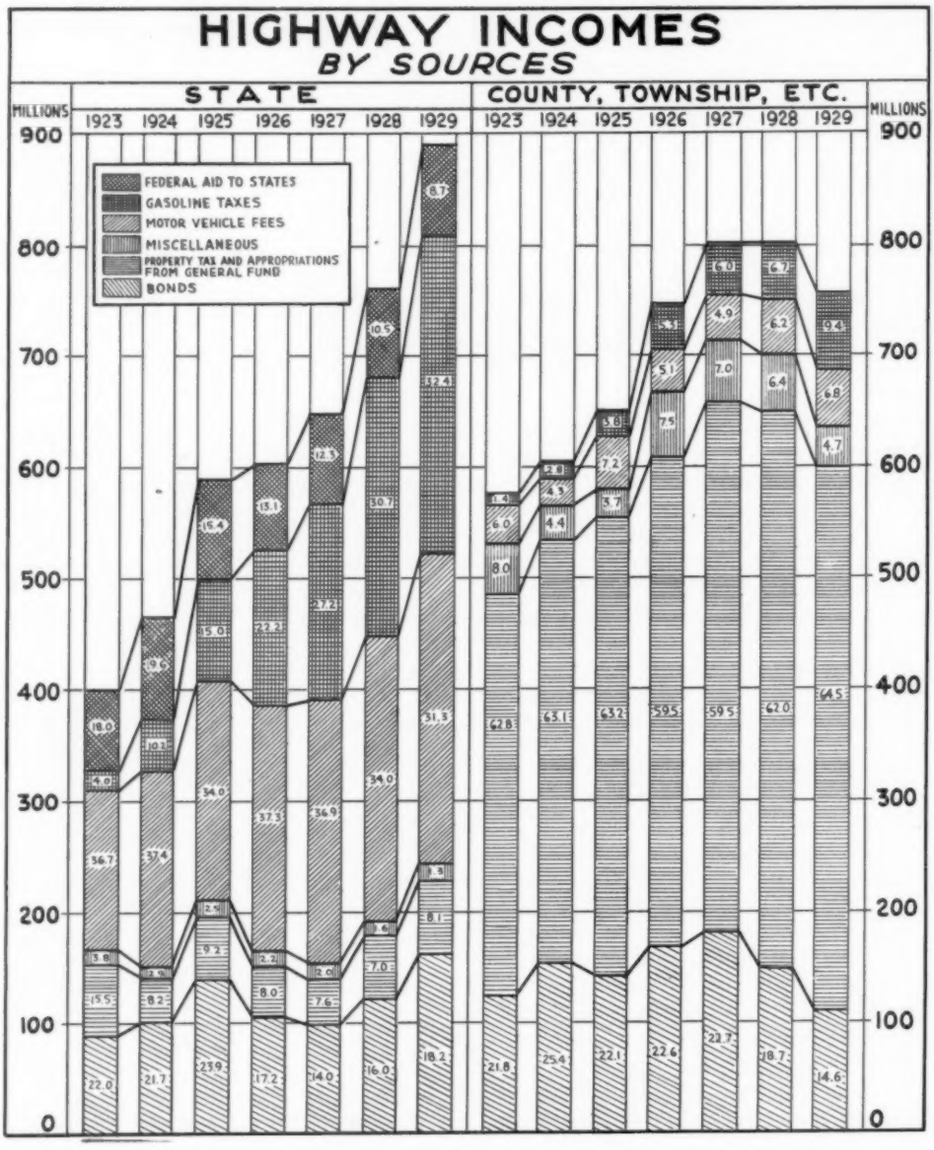
In making such a study it would be possible to search the records as far back as the early 1800's and certain information would be obtained. The records, however, are so incomplete, so out of date and the requirements of the people have been so greatly changed since that time, that the findings would merely have an historical value.

Sufficient data are available, sufficiently complete for camparative purposes, by turning the pages back to 1923. This review, therefore, will confine itself to the period from 1923 to 1929 inclusive—the latter year being the most recent for which complete figures are available.

Federal-Aid Funds for Road Building.—The federal government has provided funds at various times for the building of roads. One of the first appropriations for other than military purposes was made in 1806. In 1916 the Federal-Aid Road Act was approved. This act provided $75,000,000 to be expended over a period of five years, the last installment of which amounted to $25,000,000 and was available for the fiscal year of 1921. This act was followed by congressional approval on Nov. 9, 1921, of the Federal Highway Act, which appropriated $75,000,000 for the fiscal year 1922. Under this latter act our present federal-aid highway system has come into being. It was stipulated that the expenditures of this fund should be made upon a definite system composed of 7 per cent of the total designated mileage of each state. Approval by the Secretary of Agriculture was necessary before the state could participate under the act.

The states were obligated to design this system with three-sevenths as primary roads of interstate importance, therefore of national importance; the remainder to be of inter-county importance. The former naturally would provide a connected system of the larger and more populous cities in the different states; the latter would connect the important places within the individual state and also form connections with the interstate routes. All this has been done.

Since the passage of this 1921 act varying amounts have been approved. In 1922 the Post-Office Appropriation Act provided for $50,000,000 for the fiscal year 1923; $65,000,000 for 1924 and $75,000,000 for 1925. In February, 1925, an appropriation of $75,000,000 was made for each of the fiscal years 1926 and 1927. In 1926 similar amounts were made available for the fiscal years 1928 and 1929. In 1928 $75,000,000 was again made available for each of the fiscal years 1930 and 1931. The congress which was in session early in 1930 approved an additional $50,000,000 for the fiscal year 1931, and $125,000,000 for each of the years 1932 and 1933 so that at the present time the regular appropriation is one of $125,000,000 for aid to states and usable on 7 per cent of the states' registered and approved mileage.



Classification of Highway Mileage.—To the layman these funds are large. They are, however, relatively small portions of the total annual expenditure for road purposes—construction, maintenance and administration.

There are in the United States at present 3,016,000 miles of designated public roads. For purposes of comparison this mileage will be divided into two classifications: those under the immediate control of the various state highway departments, having a grand total of 314,136 miles as of 1929 as one class, and all the remaining roads as the other. Under this latter class, there is a total of 2,710,097 miles as of 1929. The former group will be classified as state roads, the latter as county and township roads. The former are under the jurisdiction of the 48 states with the federal government assisting; the latter, according to prudent estimates, are under the jurisdiction of approximately 10,000 separate and distinct units, composed of counties, townships and special assessment and special road districts. The greater facility of administration which exists in the former group as compared to that in the latter group is most obvious. Even the layman can recognize it. Boundary lines in the former are, and have been, fixed for some considerable period of time; hence it should be easily possible to plan definitely, accurately and progressively; to keep records of necessities; to allot funds as and where needed; to adopt an administration policy which will be in line with consistent progress, and, in the main, to formulate a policy which will be consistent with the demand.

In the latter group, the special assessment and special road districts may cover areas greater than, or at least not wholly within, the boundary of a single county. However, in approximately 99 per cent of the cases, the 10,000 units are not greater in area than the county in which they are located.

In continental United States we have 3,066 counties. Of these, 69 in the New England states do not participate in the construction of roads as counties. In other states the township is the non-functioning unit. In the main, however, in addition to the 3,000-odd counties we have about 7,000 units for which taxes are collected and which units are expending tax moneys on roads either for construction or maintenance, or both.

Highway Administration Policies.—The policies of administration in connection with state highway systems are becoming more or less similar at least with each biennium. It is only reasonable to believe that such will be continued until at some time, perhaps in the not-too-far-distant future, the only difference between any two

of them will be owing to some peculiarity which exists in one state and not in the others.

The administration policies of the other units (other than the state departments) are as widely divergent as the poles. Some states do not have county systems, some do not have township systems; in some states we do not find special districts; in some states the counties receive aid from the state; in others, the townships; in still others, both; in some states the county contributes to the state.

The writer recently had the opportunity of meeting with a number of county and township officials in a midwest state. At one of these meetings, five counties were represented and five different administration and financing policies were also represented. It would appear that the county and township units are quite a long way from deciding which of the many existing administration policies is the best. It is quite possible, therefore, that this condition is one of the main retarding factors in the providing of more adequate surfaces on those roads which are not included in the state highway systems. The minor polical units have under their control approximately 90 per cent of the total rural road mileage. About 15 per cent has been surfaced in some degree and the present rate of improvement is in the neighborhood of 1½ per cent annually.

Basic Problems in Highway Financing.—Two basic problems are in the immediate foreground in connection with highway financing. The first pertains to the sources from which the funds shall be collected; the second is one of distribution or allocation of the funds collected.

Harry K. Kirk, chairman of the Committee of Highway Finance of the Highway Research Board in a recent discussion of this question, approached it under four separate aspects: the road user, the abutting property owner, the community and the state. These four entities, if they may be so termed, are those who will benefit from the increased facility provided through the development of more adequate roads. In general, therefore, each should pay for his share in accordance with the benefit received.

In the opinion of the writer the nation must be included among those who benefit for this reason: two groups of industries have materially benefited in the road-building program and must necessarily continue to benefit in the continuation of the program. These industries are those which have profited through the manufacture and sale of transportation equipment as the first group and those industries which have received stimulus through the expansion of their markets on account of the increased transportation facility. In both these groups of industries must be included the labor and capital involved. Neither of them can be classified from other than a national standpoint and therefore the nation as a single unit derives a material benefit from the road construction program.

A few moments' thought will readily convince one of the utter impossibility of drawing distinct lines of demarkation between any two of these groups. In many instances, but particularly in the instance of the rural property owner, we find he must be included not only as a property owner but as a road user and member of the community, the state and the nation. The city-dweller may or may not be a property owner. He may or may not be a rural road user; nevertheless he is a benefactor by reason of his increased ability to sell his labor to industries which are interested in the manufacture of equipment used in transportation, in construction and maintenance; to industries which are interested in manufacture and sale of materials, and to industries which have been able to expand their markets because of increased highway transportation and travel facilities.

Many divergent ideas have been set forth as to which of these interested groups should be called upon to contribute towards the cost. Originally it was contended that abutting property owners should pay the entire bill for both construction and maintenance. Later it was agreed that the road user should take care of the maintenance cost. There are those who contend that the trunk lines at least should be supported from general funds. For some time past statements have been made that the federal government should take over, for both construction and maintenance, a system of national roads.

The Question of Accruing Benefit.—The question of accruing benefit is one on which considerable study should be made and serious attempt made to reach a workable agreement. In connection with it, "ability to pay" must, of necessity, be given consideration.

The "increase-in-value" benefit which accrues to abutting property, by reason of a usable road being made available to its owner or resident, is purely a paper profit until, by reason of sale of the property, the benefit becomes a cash increment. It must be added to the price received over the value of the property prior to the construction of the road if it is to become a tangible benefit. Until then it remains as a "paper" profit.

The person who is resident upon the property will, beyond any question of doubt, receive a benefit by the construction of the road, but that benefit will be one of increased facility in and reduced cost of transportation. This transportation may be in connection with merchandise marketed, or in providing him with better facilities for traveling to his place of employment. His benefit will be in the ratio of the usability of the road throughout the entire year. The increase in the value of the land may or may not increase the income either from a production or an employment standpoint, hence the actual increase in land value is not a true cash or financial benefit (providing, of course, he does not sell the property in question) but is a transportation benefit. To tax the benefit accruing through increase in the land value, it would be necessary to adopt a sales tax to be imposed at the time the property is sold.

Disadvantage of General Property Tax.—There is another disadvantage in the use of the general property tax, particularly on property which is not directly or immediately abutting. In most communities, whether they be county, township or specially created districts, a blanket assessment is made and each property owner in the territory pays at a rate per unit—per acre in most cases—yet the resident on the immediately-abutting property receives a greater value than the resident who is even as little as ½ mile removed. Such an inequality will invariably continue to exist as long as the general property tax continues as a source of revenue.

In addition to the transportation benefits which accrue to property owners and residents, there are certain social benefits which cannot be calculated in monetary terms although they actually are of considerable financial worth. Such advantages as improved social intercourse, better educational facilities, increased facility for fire protection, increased ability in selection of household and personal necessities by reason of greater ability to visit more distant sales places, increased advantage by reason of a wider range of marketing places, are of tremendous value to the rural dweller. Perhaps, therefore, it is reasonable to argue that the imposition of a tax on property is actually in lieu of a tax on these latter benefits.

However, this latter group will benefit the manufacturer and the agent, who receives his income from the manufacture and sale of the merchandise, equally with the buyer. There is no question but that better roads are of advantage to the people who live on or near the improved road, whether they be farmers or suburban dwellers. One difference lies in differentiating between the farmer and the suburban dweller (by suburban dweller is meant those who reside outside of cities and who are employed elsewhere). The farmer, to carry on his business of farming, must reside outside of the populated centers and does so for business reasons. The suburban dweller, on the other hand, resides in the suburban territory for personal and not necessarily for business reasons.

The general principle of taxing property as such for road purposes has very few sound reasons for remaining in existence. When this country was originally inhabited, a man's landed worth was his total worth and represented his income-earning capacity, his ability to pay and the benefits he received from the operation of governmental activities. The individual today who does not possess any property—real estate—may or may not, from the standpoint of occupation, be able to benefit from the operation of the government to an extent equal to, or even greater than, the property owner. Certainly it cannot be stated that the value of his property represents his income-earning capacity, or his ability to pay, particularly in view of the fact that he does not own any property. Even those who contend that abutting property benefits financially from the improvement of roads must recognize that the benefit received is not necessarily in proportion to the cost of the improvement. Farmers, in particular, require usable roads. However, they do not require such types as are necessary on the more important roads (which in many instances include county trunk roads as well as state trunk roads) and which types are made necessary by city and town-owned vehicles.

There are many other feasible arguments in support of those who contend that property (real estate), as such, should not pay more than a very small, if any, portion of the road bill. However, several facts must not be lost sight of. First, motorized transportation is the only efficient means of vehicular travel; second, there are not sufficient roads in existence to supply the needs of the people in this nation; third, roads cost money, therefore money must be obtained to pay the cost. Admittedly, this is no argument to say that property tax should pay more than its share. The statement does signify, however, that a thorough study is seriously needed.

Sources of Highway Income.—The various sources from which moneys are received and which are available for the building and maintenance of highways are listed in Tables I and II[1]. Table I covers the years 1923 to 1929, inclusive, relative to state roads and Table II is for the same period but for county and township roads. In Table I it will be noted that the trend of the percentage which property tax and appropriations is of the total income is towards reduction. The actual amount of the annual tax on property has not decreased materially. In fact, this source contributed as great an amount in 1929 as in 1923 and the 1929 amount is more than 30 per cent larger than the average collected annually. The decrease in percentage is caused by an increase of 121.5 per cent in the total income available in 1929 over the available of 1923 and is not caused by any reduction in the amount collected through property tax and appropriations from general funds. Another interesting fact in this connection is that in 1921 approximately 35 states levied a tax on general property for use in road improvement, whereas in 1929 the number of states making such levies has been reduced to 27, according to reports by the National Automobile Chamber of Commerce. In fact, the "property tax" figure listed under 1929 is solely that of 13 states and the "appropriations" only for 19 states, hence it is reasonable to assume that when the total figures are available this amount will be greater than that listed in this table. If such is the actual condition —that the amount collected in 1929 by 13 states is 30 per cent greater than the average collected by all states during this period and is equal to, if not greater than, the total property tax collected by all states in 1923—is it not reasonable to contend that the property tax levied by these 13 states must have increased considerably during this period?

Under the present tax system, it is to be expected that general property will contribute materially more towards the county and township highway funds. A hasty glance through Table II supports this expectation. It also shows that the percentage which property tax and appropriations was of the whose has varied over a range of 14 per cent but that the variation has not been consistently up nor down. In percentage contribution it remains reasonably constant during the first three years, having a variation of only 0.4 per cent, although the gross amount was upwards in each case. The annual change over the previous year in collections from property tax and general funds appropriations for county or township roads has been as follows:

1924	over	1923,	increase	of	6.0	per	cent
1925	"	1924,	"	"	7.7	"	"
1926	"	1925,	"	"	7.3	"	"
1927	"	1926,	"	"	7.9	"	"
1928	"	1927,	"	"	4.4	"	"
1929	"	1928,	decrease	"	1.9	"	"

The first material change in percentage, which property tax and appriations is of the whole, is found in 1926. This year provided a decrease of 3.7 per cent; the actual collection was 7.3 per cent greater than that of 1925. The percentage decrease therefore was not owing to a decrease in the general property tax. The reason for this decrease is found in the increase of the total income available over that of the preceding year. In 1927 an increase occurred in both the total amount collected from all sources and the amount collected from property-tax and general-fund appropriations.

The available income in 1928 was only very slightly greater than that of 1927. Both these years were considerably higher than the available income as reported in 1929. The amount received from property-tax and general-funds appropriations in 1928 as compared to 1927 was greater than that of the preceding year by 4.4 per cent or the following year by 1.9 per cent. The amount received from this source in 1929 was greater than that of 1927, although the total available in 1929 was considerably less than that available in 1927. It will be further noted that the percentage which property tax and general funds appropriation were of the whole is greater in the year 1928 than any other under consideration, while in 1929 it was only slightly less. The funds listed as miscellaneous in Table II must very largely be obtained from general-fund appropriations or from special-fund appropriations, but are, in the main, originally obtained from property tax. The amount received from bonds must also be considered as being very largely from property tax. This is not true, however, as of Table I.

[1]The figures of these tables for the years 1923 to 1928 inclusive are from the Highways Hand Book, 1929 edition, published by the Highway Educational Board. The figures for the year 1929 are from the National Automobile Chamber of Commerce and are reported to be from official sources.

TABLE I—STATE HIGHWAY INCOME TAX SOURCES

Source	1923 Amount	1923 Per Cent of Total	1924 Amount	1924 Per Cent of Total	1925 Amount	1925 Per Cent of Total
Bonds	$ 88,186,784	22.0	$101,653,327	21.7	$141,402,022	23.9
Property Taxes } Appropriations }	61,810,057	15.5	38,367,202	8.2	54,879,646	9.2
Miscellaneous	15,498,492	3.8	13,349,610	2.9	15,051,966	2.5
Motor Vehicle Fees	147,075,966	36.7	174,816,973	37.4	199,845,163	34.0
Gasoline Taxes	15,872,884	4.0	47,810,615	10.2	89,328,340	15.0
Federal Aid	72,343,401	18.0	91,400,832	19.6	92,180,406	15.4
Total	$400,787,584	100.0	$467,398,559	100.0	$592,687,543	100.0

Source	1926 Amount	1926 Per Cent of Total	1927 Amount	1927 Per Cent of Total	1928 Amount	1928 Per Cent of Total	1929 Amount	1929 Per Cent of Total
Bonds	$103,846,301	17.2	$ 90,979,230	14.0	$121,483,599	16.0	$161,229,297	18.2
Property Taxes } Appropriations }	48,147,042	8.0	49,564,206	7.6	54,424,168	7.2	{ 11,431,349 } { 60,305,631 }	8.1
Miscellaneous	13,223,531	2.2	12,521,969	2.0	12,611,916	1.6	11,726,508	1.3
Motor Vehicle Fees	224,551,631	37.3	239,955,128	36.9	259,134,820	34.0	278,092,734	31.3
Gasoline Taxes	134,303,154	22.2	176,769,657	27.2	234,163,826	30.7	287,258,416	32.4
Federal Aid	79,163,201	13.1	80,159,671	12.3	80,798,365	10.5	77,572,691	8.7
Total	$603,234,860	100.0	$649,949,861	100.0	$762,616,694	100.0	$887,616,626	100.0

TABLE II—COUNTY AND LOCAL HIGHWAY INCOME, 1923-1929

Source	1923 Income	1923 Per Cent of Total	1924 Income	1924 Per Cent of Total	1925 Income	1925 Per Cent of Total
Bonds	$125,753,573	21.8	$153,846,816	25.4	$144,413,116	22.1
Taxes } Appropriations }	361,664,535	62.8	383,280,745	63.1	412,825,227	63.2
Miscellaneous	45,362,668	8.0	26,569,235	4.4	23,966,034	3.7
Motor Vehicle Fees	34,438,385	6.0	25,941,072	4.3	46,545,445	7.2
Gasoline Taxes	8,419,446	1.4	17,136,290	2.8	24,833,979	3.8
Total	$575,638,607	100.0	$606,774,158	100.0	$652,583,801	100.0

Source	1926 Income	1926 Per Cent of Total	1927 Income	1927 Per Cent of Total	1928 Income	1928 Per Cent of Total	1929 Income	1929 Per Cent of Total
Bonds	$168,575,423	22.6	$181,080,953	22.6	$150,222,357	18.7	$110,635,146	14.6
Taxes } Appropriations }	443,046,762	59.5	{ 405,219,774 { 72,692,737	50.4 } 9.1 }	$498,761,559	62.0	{ 414,152,567 { 75,018,526 }	64.5
Miscellaneous	56,242,683	7.5	56,535,744	7.0	51,133,653	6.4	36,228,366	4.7
Motor Vehicle Fees	37,861,018	5.1	40,239,856	4.9	50,433,055	6.2	51,886,324	6.8
Gasoline Taxes	39,733,227	5.3	46,860,508	6.0	53,778,852	6.7	70,492,878	9.4
Total	$745,459,113	100.0	$802,629,572	100.0	$804,329,476	100.0	$758,413,807	100.0

In connection with bonds for state highway operation, the refunding and interest payments are very largely obtained from "user" taxes—the motor vehicle and gasoline taxes. This fact is becoming more consistently true each year. This provision is usually stipulated at the same time the legislative authorization is given to "float the issue." State bonds therefore are not truly an additional income but are the capitalization of that income which will normally become available and for which taxing methods are already provided. The income received from bonds in connection with county and township roads (Table II) cannot, however, in general, be considered as capitalization of user-tax income. It must more truly be classified as additional funds, the refunding and interest charges of which must be provided for through additional taxation.

The "user" taxes, therefore, in connection with Table II are bonds, motor-vehicle fees and gasoline taxes, as compared to the "user" taxes in Table II—motor-vehicle fees and gasoline taxes only. It will be seen in both tables that the "user" taxes are increasing. The amount available from motor-vehicle fees in Table I has increased approximately 100 per cent. The amount available from gasoline taxes has increased many hundred per cent. In Table II the motor-vehicle fees and gasoline taxes have also provided increasing amounts in both percentage and total collected.

There are several reasons for these increases in "user" taxes. They are due, at least in part, to increases in the amount of tax imposed on each unit per gallon in the case of fuel and per car and truck in the case of the vehicle. In addition to this, many more gallons of fuel were consumed and many more vehicles registered in 1929 than was the case in 1923.

The percentage of annual increase in registration has declined, as will be seen in Table III. It has been estimated that the increase in 1930 over 1929 will be approximately 3 per cent. From this it will be seen the per cent of annual increase is becoming smaller. It is reasonable, therefore, that in the main whatever increases occur in these "user" fees from now on must be largely either increases in amount collected per unit or increases in fuel consumption per vehicle. In this latter connection it is impossible and utterly futile to attempt any forecast on the amount of fuel consumption. The possibility of increasing the unit-tax on either fuel or vehicles is decreasing very rapidly, hence it is not difficult to visualize the time when the user tax will remain fairly constant.

TABLE III—MOTOR-VEHICLE REGISTRATION

Year	Number of Vehicles	Increase over Previous Year	Per Cent Increase over Previous Year
1923	15,092,177	.....	....
1924	17,593,677	2,501,500	16.6
1925	19,937,275	2,343,597	13.3
1926	22,001,393	2,064,119	10.4
1927	23,127,315	1,125,922	5.1
1928	24,493,124	1,365,809	5.9
1929	25,851,124	1,358,000	5.5

Let us turn now to the question of bonds. In view of the fact that most economists advocate the use of bond issues, rather than the so-called pay-as-you-go system of financing highways, only when there is no well-defined system in existence, one would anticipate that the utilization of bond-issue method would decrease as times goes on. The income from bonds, as shown in Table I in connection with state roads, would lead one to believe one of two things—either that this theory has been, and still is, entirely disregarded, or else the time has not yet arrived when a fairly well-established system is in existence. Yet anyone who would dare make the latter statement would be placing himself in an unfortunate position. Obviously it would be a ridiculous statement, as anyone who has the least familiarity with existing conditions must agree. It would not be impossible to contend that this theory was the basis of reasoning during the years 1923, 1924 and 1925 and that from that period on a decline—similar to that which occurred in 1926 and 1927—would be the normal expectancy. The year 1928, however, throws the idea entirely into discard, as does 1929. Undoubtedly the true reason for the variations in the annual amounts receivable from bonds is that this method of financing has not received general usage consistently over the entire country. In connection with Table II the difficulty of classifying the variations in annual amounts from this source is greater almost even to the extent of being an impossibility.

Summary.—1. The requirements of the people of this nation are not yet taken care of; consequently the road building program must be carried on.

2. Bonds may continue to be used or their use may be considerably increased. If so, it will likely be as a means of capitalization of income and not as additional income.

3. Although the amount of property tax and appropriations from general funds devoted to state roads was greater in 1929 than in 1923, the general tendency is for this source to provide diminishing amount by reason of legislative action; a lesser number of states used this source as a means of revenue in 1929 than did so in 1923.

4. The tendency to reduce property tax may also be expected in connection with county and township roads, which factor will have a retarding effect on the use of bonds as a means of providing additional revenue.

5. Miscellaneous funds provide a relatively small amount of the total income for state roads, which has remained fairly constant. In connection with county and township roads this source is largely obtained from property tax and therefore can be expected to show the same tendency.

6. The trend of annual increase in number of motor vehicles registered is downward. Therefore, the income available from this source will have a tendency to remain fairly constant unless the amount of tax per unit is increased.

7. The amount of annual increase in funds available by reason of tax on fuel cannot be expected to continue at more than the present rate per annum, unless the amount of tax per unit is increased.

8. The question of federal aid for road building cannot be predicted as to increases, from these figures. It has been increased by 66.6 per cent for the fiscal years 1931, 1932 and 1933.

9. The factor, public sentiment, is not revealed in these figures. It is well known, however, that much difficulty is being experienced in increasing the amount of the tax per unit on both vehicles and fuel.

10. The increasing or enhancing of efficiency in administration practices, the development of definite and coordinated plans, following analyses of present conditions and practices should result in greater returns to the taxpayer and create a greater desire for increased activity.

Efficient Use of Road Improvement Funds

By A. F. Becker
County Commissioner, DuBois County, Ind.

WHEN planning a county road budget, it is important to give much time to determine the amount of traffic passing over certain of the roads in order to make the proper allotment of funds. It would be unwise to pro-rate the repair money on the basis of the sum of money paid into the county road repair fund by a certain township and then spend just that much money in that township, divided equally on each mile of road therein. There are many people holding this view and probably there are some county officials who are like-minded on this question. It is the unqualified duty of the commissioners and road superintendent to determine which of their respective county roads are of primary traffic importance and to classify them in order as to public service. There would then be a very good basis on which to fix the budget allotment according to the amount of use or travel on the several classes as they have been designated on the county map. This plan may be contrary to the wishes of some taxpayers who are inclined to tell the road officials just where and how the money should be used. But the officials are held responsible for the condition of all the improved roads in the county, and that alone puts the question right up to them to use their own good judgment as to where the most work shall be done and how the money shall be spent.

Expenditure of Funds.—It is true that all property holders pay a proportional amount of taxes as based on their valuation. They generally feel that the road along their property is the *one* road needing much repair and the superintendent should give it more attention than he does. If we were guided by these views, we would have only main or primary roads in our counties and the state would also have but one class of roads. It can readily be seen that such a plan would not be satisfactory to the citizenship of the community. There are some roads which are outstanding and prominent in their use and location, usually linking together important community centers or greater trading points; these of necessity require greater expenditures per mile to keep them in good condition.

The best equipment and the manner in which it should be used are very much questions of soil and the various metals used in road construction in the territory. To some extent there enters the question of the kind of men

that are employed to handle the equipment. If they are men who take a personal pride in the work, much disappointment should not be experienced in the results obtained with most any kind of suitable or standard equipment. However, if the payment of political debts is the only basis used in selecting employees, there will no doubt be much inefficiency and waste, and a disappointed taxpaying public will heap righteous condemnation upon the officials.

Another picture of poor supervision of public road funds is the case where some anxious petitioners find that there is a certain sum of money available for construction of roads and they immediately set out to have the commissioners order their particular road built. Then it is found that the improvement made under well-recognized standards will cost more than the amount of money available. When the interested parties or petitioners learn of this situation, there is generally a demand for a revision of the plans and specifications to cheapen the road. If this demand is entertained and accepted, it results in an inferior road. In the end it only means more trouble and aggravation for the commissioners and road superintendent because the road will not stand up under traffic as expected and will be a constant source of maintenance expense. The county as a whole will be called upon to finish building this road from the road repair fund, otherwise it will stand as a black mark against those responsible for its construction.

Experience teaches that it is well to have a fair and liberal estimate for contract work of any kind. This is the first step toward being fair and honest with the contracting party. Thereafter it can be demanded of the contractor that he perform according to plans and specifications, and officials should not fear to enforce their demands that he live up to his contract.

Inspection.—The enforcement of the provisions contained in the plans and specifications adopted requires the proper supervision by a fair and competent superintendent of construction. A common difficulty is that of obtaining a competent construction superintendent at the prevailing low rate of pay. In DuBois County the county engineer recognizes the laxity of the unfair law pertaining to pay for construction superintendents on roads and takes it upon himself to make the necessary inspection on bridge construction and the grade on roadways before the metal is placed. We try to get a competent person to watch so that we get the required amount of metal on the road. The engineer also checks up on this item from time to time.

Contracts.—By the adoption of standard plans and specifications, with a fair and liberal estimate, county officials can expect fair competition in the number of bidders attracted. This in turn usually means a fair price for the job, together with good workmanship and the least possible delay in construction. A fair and honest estimate of proposed work to be done, a fair and honest group of bidders and a fair and honest engineer and superintendent on jobs to be done go a long way to make satisfied taxpayers. We should not take advantage of a contractor after having entered into a contract by requiring him to do more than his contract calls for. Instead of making it unpleasant for him if he should refuse our demands, we should be honest enough to admit our own mistakes in approving plans and specifications which do not contain what we want, after the work is in progress of construction. This policy also holds good in the event error is discovered in the plans after construction is under way.

Bridge Maintenance.—Another outstanding piece of neglect on the part of public officials involves their failure to clean and paint all steel bridges at regular intervals. These have been constructed in many instances at a great cost to the taxpayers and should not be neglected. In DuBois County our board members have been endeavoring for the last two years to encourage and stimulate our township trustees to clean and paint all bridges which the county has constructed for them. That has not been a very pleasant task. It seems to be the opinion of most trustees that the county must take care of all bridges built by the county for the townships. In all fairness to our trustees, with a few exceptions, they have responded well to the demands of the board of commissioners in the program of keeping township bridge structures in repair and paint.

County Surfacing of Township Roads.—Concerning the "gap law" as it is commonly known, or the law which permits townships to grade and drain roadways and then have them taken over by the county for a metal surfacing, I want to give my observations on this practice in a neighboring county of which I have been taking notice the last two years. DuBois County, so far, has not been called upon to take over any of the above-designed propects, so I had to go to a neighboring county for my observations. The information I gathered from the auditor was that the county in question had graveled some 12 or 14 miles of roadway this year. Most all of this mileage was on flat lands; consequently not much grading was required. There were no waterways which called for bridge construction. It can readily be seen that no great expense was encountered by the township in preparing the roadway; therefore a considerable mileage could be turned over for county upkeep and repair.

On first consideration this method appears attractive, but something cannot be obtained for nothing. The county has no funds available to be used for surfacing roads excepting the gasoline-tax funds, which may be used for construction as well as repair of highways. This fund, derived from the state gas tax, is used for the above-mentioned township road improvements, but I seriously question whether the real intent of the law was to supersede the present laws providing ways and means to establish and improve roads in counties and townships. It may be reasonable and sensible to use some of the gas funds in certain cases—for instance, where there remains an open and unimproved gap in a road and the township has reached its bonded-debt limit. But even so there remains the county unit law which can be applied in such cases. It is my opinion that it was the intention of the county unit law to use county funds to construct roads connecting improved roads where the township funds are not available or in townships not having a great sum of taxable valuation.

I find that the mileage is increased in improving township roads with county funds but this is done at the expense of the roads already built in the regular way and which are entitled to the necessary repair and replacement of metals for which the repair fund was created. The gas tax is a part of the repair fund. It is very noticeable in the above-mentioned case that the other roads are suffering for lack of material and attention because of the depletion of funds caused by the county using its repair money for placing metal on roads taken over from the township. How much benefit does a road receive from a layer of gravel or stone 1½ to 2 in. in thickness when wet weather comes? This is the usual amount of metal on these roads which I observed.

Acknowledgment.—This paper was presented at the 17th annual Purdue Road School.

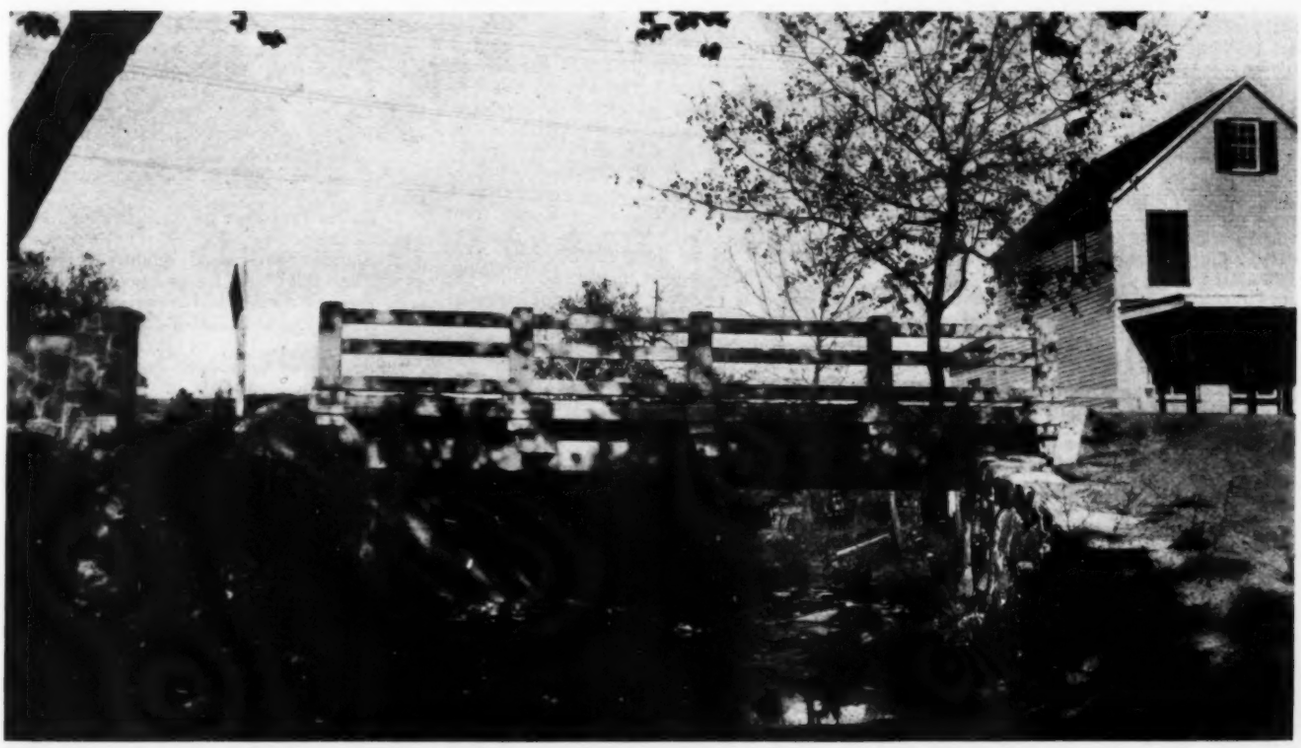
BEFORE

A Bad Spot on Virginia Route 327 Before This Road Was Given Surface Treatment

Old Bridge over Falls Run Creek on Virginia Route 327

AFTER

The Same Spot, Scarcely Recognizable After the Application of a Surface Treatment



New Structure Replacing the Old Falls Run Creek Bridge

The Road Builders' News

Summaries of Reports Contained in A. R. B. A. Proceedings

The forthcoming *Proceedings* of the American Road Builders' Association, which are now on the press, will contain a new idea in the publication of such books. The association believes that the book will be more useful than ever before. The new idea is this: Summaries of each report consisting of an introduction, a résumé of the report and conclusions will be presented for each of the committees. These summaries give all the important facts condensed to make easy reading and to convey the maximum of information. Only useful facts are presented.

The conclusions have the approval of the various committees and, as in past years, they represent the opinions of leaders in the highway industry—state, county and city officials, contractors, manufacturers.

The complete reports with supplementary data collected by the research staff of the association will be printed in a series of bulletins. These bulletins will appear in a uniform style with a standard cover. The bulletins will be distributed free to members.

The *Proceedings* are available free of charge to members of the American Road Builders' Association; to others the price is $5. The book will contain about 400 pages, fully illustrated with halftone cuts, diagrams and tables, and will be bound in the standard blue leather cover adopted several years ago.

The *Proceedings* of the American Road Builders' Association contain the latest standard practice in the financing, construction, maintenance and use of roads and streets. The conclusions have been quoted and referred to by many eminent road builders as being highly useful and giving the most recent ideas about road and street practice.

"I believe that the *Proceedings* of the American Road Builders' Association have achieved a permanent place in the working library of every road builder," comments Chas. M. Upham, engineer-director of the association, "and one indication of the universal acceptance of these *Proceedings* is their adoption by a number of engineering schools as a standard text book and reference work."

Stanley Abel New Vice President of American Road Builders' Association

Stanley Abel of Taft, Calif., has been appointed a vice president of the American Road Builders' Association to fill the vacancy caused by the death of the Hon. Samuel Hill of Seattle, Wash., who was an officer of the association for many years.

As former vice president and president of the County Highway Officials' Division (1930-31) Abel has become familiar with the work of the association and marked progress was made in aiding counties during his administration. He was chairman of the county committee on regional surveys and plans for several years and is now chairman of the county committee on public relations which made a report at the annual convention of the association in St. Louis in January.

Abel is secretary of the County Supervisors' Association of California and a member of the Board of Supervisors of Kern County, California. He was a member of the special committee appointed by the governor of California to study railroad grade crossings.

He is owner and editor of the *American County* and *Highway Maintenance* magazines published at Taft Calif.

A. R. B. A. Leading in Study of New Problems

In the three decades the American Road Builders' Association has been engaged in acquiring and distributing information about highway finance, construction, maintenance and use, a tremendous development in roads and streets has taken place. The work of the association has grown to keep pace with this development.

With the increased popular demand for smooth, wide and strong highways there have come new problems of finance, design and construction, the tremendous increase in passenger and freight traffic on the roads and the use of machines and improved materials for nearly every phase of road work.

The strong impetus given to road building by the demands of an ever increasing traffic and the change in the character of that traffic is reflected in the larger appropriations for road work, increased employment for road builders, and greater business for manufacturers of equipment and materials. It is the work of the association to represent all of these interests.

To stimulate interest in road building the association is engaged in the promotion of road programs to improve the facilities for travel, decrease congestion and assure the public of adequate roads and streets.

The scientific or research activities of the association are widespread. Unfettered by restrictions, the staff engineers work continuously under the direction of committees of leading state, county and city officials, contractors and manufacturers to standardize road and street practice and to discover new facts. Information as to methods and materials is analyzed impartially and the facts found and the conclusions drawn are presented at the annual convention and in the *Proceedings* and bulletins which have wide circulation.

Road shows of equipment and material which provide demonstration of design and use are held annually. The annual convention is held at the time of the road show so that a representative gathering of road and street builders and officials is assured.

"Affiliated Associations" Formed by County Officials

Following the lead of California, Delaware and New Jersey, county highway officials' organizations are affiliating with the County Highway Officials' Division of the American Road Builders' Association, according to a statement from that association. Various other state organizations are considering similar affiliation.

"This action recognizes the importance of the county as a highway administrative unit especially pronounced in states such as New Jersey and Illinois where state highway systems are approaching completion. Leaders in highway thought in every state recognize the increasing importance of county highway administration," said Stanley Abel, secretary, County Supervisors Association of California. "The work of the County Highway Officials' Division of the American Road Builders' Association is to accelerate the development of improved standards in county highway operation."

Under the plan of organization by which the 38 state associations of county highway officials may become affiliated with the County Highway Officials' Division of the American Road Builders' Association the officials of the county highway associations are made members of the County Highway Officials' Division without cost and the county associations become known as "affiliated associations."

The purpose of this nation-wide organization is to unite, cultivate, stimulate and use every good influence for the upbuilding of county organizations for highway work throughout the country. Also, an effective agency for the standardization of administrative, construction and maintenance practice will be established.

Representatives are appointed from each state association. In addition to the president and secretary of the state association, there is one representative for each 10 counties represented in the state association.

The results to be obtained from this organization of "affiliated associations" include:

1. Easier exchange of ideas between state associations;
2. Standardization of county highway practice;
3. Participation in the affairs of the American Road Builders' Association by representative groups of county officials;
4. Assurance of proper representation to county highway officials in respect to other interests identified with the highway industry through the American Road Builders' Association;
5. Appropriate national recognition of county highway officials' associations.

The membership in the American Road Builders' Association is growing at a rate of 35 per cent annually. The type of membership has changed in recent years so that at the present time only men active in road building are represented.

The annual meeting of the American Road Builders' Association is held in May; the 29th annual convention and road show will be held in January, 1932.

Employment for Labor Stops Gas Tax Diversion

Employment for labor on the highways as well as the demands of traffic for better roads have stopped attempts to divert the gasoline tax to purposes other than highways in most states according to a statement of the American Road Builders' Association, Chas. M. Upham, engineer-director.

"Since the days in Boston when the horses were decorated with covers proclaiming 'I want good roads,'" commented Mr. Upham, "there has been developed a demand for road improvement so great that automobiles do not have to be decorated with similar signs."

A number of states have diverted the gasoline tax but the total is less than 3 per cent of the amount collected. Money has been used for all kinds of things not related to roads. Kentucky is buying Mammoth Cave with gasoline tax money; Maryland supports a conservation department busy with oyster propagation. Florida, Georgia and Texas diverted in 1930 a total of $13,040,200 to the support of schools —the largest single item of diversion. Mississippi built a sea wall to the amount of $207,440. New York City receives 5 per cent of the gasoline tax to go in the general fund. Idaho and Michigan are building aviation fields using $44,000 of gasoline tax money but they are collecting a tax on airplane gasoline that partly covers this diversion. Louisiana is building a port with $155,000 of the gasoline tax money in 1931.

"The present need for providing work for the unemployed and the readiness with which men from all classes of industry can be absorbed in road building work," continued Mr. Upham, "seem to be known and legislatures generally recognize these facts. The needs of the highway are apparent to all motor-vehicle drivers. The 32,500 people killed in 1930 by motor vehicles and the 962,000 injured, not to mention nearly a billion dollars property damage, clearly indicate the need for more and better highways and streets.

"This will be the greatest road-building year in history," he continued, "and coming at a time when other work is decreased much distress will be relieved through employment given by road contractors and officials. The public will gain because roads can be built more economically in a period of comparatively low prices."

Cooperative Project of American Road Builders' Association

The large number of associations and government bureaus with headquarters in Washington affords excellent opportunity for valuable cooperative work on the part of the American Road Builders' Association.

A number of cooperative projects are in progress, notably with the Highway Research Board and the American Association of State Highway Officials under definite working agreements, the United States Bureau of Public Roads, the United States Department of Commerce on airport surfaces and export, the American Automobile Association on the widening of roads and streets, the Chamber of Commerce of the United States, the American Rural Letter Carriers' Association. This cooperation has been mutual and active.

Many officers of the American Road Builders' Association are officers or committee members of other associations and, in turn, these other associations are represented among the officers and committees of the road builders.

There are good possibilities for the further development of this cooperative work to prevent duplication of effort and to reduce the cost of investigations by assigning to each unit the part of the work that it is best fitted to perform.

Plans for City Officials' Division Work

The plans for the City Officials' Division work of the American Road Builders' Association for 1931 include a thorough study of specific details of typical city problems. The division is organized in five committees: Pavement Financing, Design and Construction, Maintenance, Traffic and Airports.

This work will be in charge of the president of the division, G. B. Sowers, commissioner of engineering and construction, Cleveland, and the executive committee, assisted by P. F. Seward, engineer excutive of the division.

Seward brings to his work as engineer a broad experience in engineering and association research work. He was educated as a civil engineer both in the United States and in France, where he served as an officer in the American army. He has had a broad experience in the design and construction of city and metropolitan area pavements in several states. As associate district engineer of the North Carolina Highway Commission he was engaged on many different types of work during the construction work of building the $115,000,000 primary road system of that state. He was construction engineer for Sarasota County, Florida, in the development of a large paving program.

With the American Road Builders' Association, Seward has been in charge of the work of several committees, including Standardization of Weighing Devices for Concrete Aggregates, Central and Truck Mixed Concrete, and Grading Methods and Grading Equipment. He is the author of numerous articles for the technical press and has prepared a number of papers and research reports. He is a military engineer member of the Society of American Military Engineers.

The effective cooperation that is being accorded the City Officials' Division by city officials throughout the country is indicative of a most successful year.

Studies for Road Builders Recommended

The useful studies of highway practice and methods of effecting economies in the financing, construction and maintenance of roads and streets made by the American Road Builders' Association have attracted the atention of road builders to such an extent that many requests have been received to undertake work of various kinds.

There are many subjects that need intensive study and at the present time the staff of the association is considering ideas that have been submitted with a view to selecting those subjects for study that will be of greatest service to all road builders.

Various equipment problems will be studied in detail together with a number of finance, design, construction and use investigations in connetcion with road and street work.

The procedure in undertaking research studies is first to select the most practical problems, then committees are appointed made up of outstanding specialists in the subjects to be considered. These committees are organized and meetings held when necessary. A staff engineer of the association is assigned to the committee, the work outlined and the investigation commenced. Some of the investigations are completed in one year, others extend over a period of years.

Results of the committee investigations are presented at the annual convention held at the time of the annual road show and complete discussion of the results is had at that time. A summary report is then prepared for printing in the annual proceedings. The complete report is printed in bulletin form and distributed to members of the association.

Road Builders Maintain Statistical Service

To supply members with the latest figures on the extent of state, county and city road and street programs, the statistical service of the American Road Builders' Association has been expanded. This service shows the status of the various activities and furnishes valuable information on which to base action. The figures are obtained direct for the various political units and are recent and useful.

Statistical work on the standardization of equipment and materials is also done and efforts are made to reduce the numberless minor variations which add to the expense of manufacture. Methods are indicated of reducing costs and preventing waste.

Among the data sheets that have been prepared are:

1. Expenditures by states with estimates as to the 1931 programs have been collected including the available funds and the kind of roads that are to be built.
2. Expenditures for counties and cities were collected in 1930 and a similar study is in prospect for the current year.
3. Permanent types of highway pavements were listed from state specifications. This information makes possible an analysis of the field or market for various kinds of materials and equipment.
4. Tabulations showing the practice in the use of reinforcing steel for pavements in different states were made. This study shows a wide variation in the practice of reinforcing which, when widely known, may be helpful in bringing about more uniformity.

The statistical service of the association has met with the approval of all who have used it and it is proposed to expand the work as occasion requires.

The American Road Builders' Association sponsored a plan for the standardization of weighing devices on concrete mixers which resulted in the simplification of these devices and made possible the use of the same machine in many states.

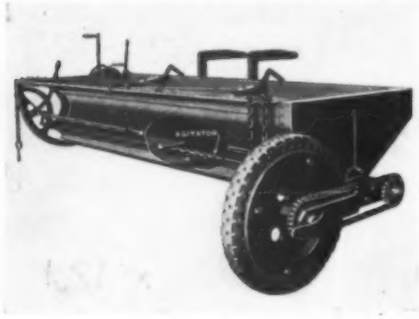
Students of engineering in the various technical schools can become student members of the American Road Builders' Association with the approval of the dean of their school. Many engineering students have become enthusiastic members.

New Equipment and Materials

Mechanical Chip Spreader

A mechanical spreader for spreading sand, gravel, stone and slag and designed to fit any standard truck has been put on the market by the N. & H. Mechanical Spreader Co., Hamburg, N. Y.

The spreader is built of heavy gauge metal and electric welded throughout. All bearings are lubricated by alemite fittings. The arms that support front of hopper are adjustable to fit any height of truck. A plow steel cable running through a series of sheaves is controlled by a ratchet lock and break wench, which lifts the entire weight of hopper onto the truck. This enables one man to attach and



N. & H. Spreader

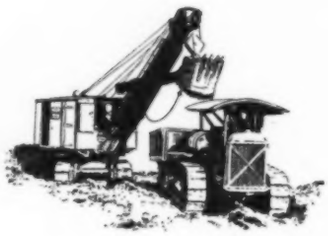
detach the machine very easily and rapidly.

The weight of the spreader and load is carried by the truck, in this manner giving the truck a free move in either direction. Material may be spread with truck moving forward or backward by simply throwing auxiliarv lever over. There are hinged doors that permit variable widths of materials to be spread from 6 in. to 9 ft. A lever at hopper end provides an easy means for regulation of slide controlling amount of material to be discharged. A twisted agitating shaft giving uniform force feed is powered by an auxiliary wheel, which is of full floating design.

New Highway Guard Rail

A new highway guard, made of spring steel, has been placed on the market by the Tuthill Spring Co., 760 West Polk St., Chicago, Ill. The guard is made of ¼x10-in. spring steel, convex shaped to increase its strength. Its smooth curved surface

Tuthill Highway Guards



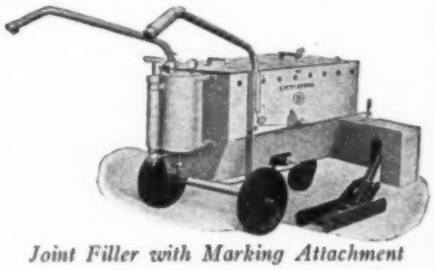
was designed to ward off contacting vehicles with a minimum amount of damage. The guard rail is placed at the proper height to receive the impact from bumpers, hub caps, wheels or running board.

The guards are secured to each post by means of a heavy spring bumper, bolted to the post at its base. This bumper is made of 7/16x4-in. finest grade spring steel.

Combination Joint Filler and Line Marker

A combination joint filler and line marker has been brought out by Littleford Bros., 454 East Pearl St., Cincinnati, O.

This joint filler keeps asphalt hot and applies it direct to the joint. Asphalt is drawn from a heating kettle into the 20-gal. tank of the joint filler. The tank is heated by two gasoline burners, one directly under the tank and another under the outlet valve. Both gasoline burners are pro-



Joint Filler with Marking Attachment

tected by windshields and it is stated will operate satisfactorily in any kind of weather.

An attachment for marking an asphaltic center line can be easily and quickly fitted to the machine, which can then fill the joint and mark a stripe from 2 to 8 in. wide. An automatic hopper that spreads sand and chips over the freshly filled joint also can be attached.

New Shoulder Finishing Device

The National Equipment Corporation, Milwaukee, Wis., announces a new shoulder finisher designed and built by the Insley Division, the purpose of which is to shape a road shoulder and berm accurately once the proper amount of dirt has been put on the shoulder. It consists of a platform mounted on pneumatic tires, this platform carrying an A-frame and column supporting a set of blades which conform to the required specifications. It is made with three sizes of blades, 8 ft., 10 ft. and 12 ft. 6 in. and can finish any shoulder from 5 ft. to 11 ft.

The unique feature of the Insley Shoulder Finisher is the use of a guide bar near the rear of the machine which bar runs along the edge of the finished slab and holds the entire machine in exact line so that the relation of the edge of the slab to the edge of the berm is automatically fixed. When the machine is used on a job other than concrete slab this guide bar is not used and the machine has enough weight and stability to enable it to carry a full blade without shifting the rear end sidewise. Owing to the distribution of the weight the Insley Shoulder Finisher can carry a full blade either with or without the guide bar.

Insley Shoulder Finisher

The main blade is adjustable up and down at both ends. It is likewise adjustable in a horizontal plane which takes care of the width of the shoulder. The slope blade is adjustable both as to angle and length.

When the machine is used on a job other than concrete slab the fact that it has steerable wheels enables the operator to line up the machine with the edge of the pavement by means of an indicator and thus get the same result as he gets on a slab job by means of the guide bar.

The usual procedure in building shoulders with this machine is to put more than sufficient dirt on the shoulder and run over the shoulder to make a rough cut. This operation is then repeated, bringing the shoulder down to the finished grade and turning the angle of the berm. The machine is pulled by a tractor running on the shoulder rather than on the slab making it possible to finish shoulders closely behind the paver.

Form Puller

A handy and useful tool for paving jobs has been placed on the market by the Moritz-Bennett Corp., Effingham, Ill. This is a tool for pulling forms. It is stated that by means of it two men can pull more than 1,000 ft. of forms per hour. The tool,

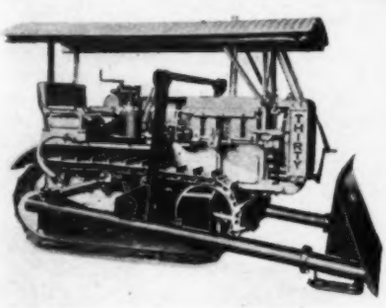
Moritz Form Puller

moreover, is stated to pull the forms up straight, thereby eliminating the chances of bending by prying. The pins also are pulled with the forms, eliminating their loss and preventing their bending. The form puller is 10 ft. long and 1 ft. 9 in. wide, and weighs 115 lb.

New Hydraulic Bulldozer

A new hydraulic bulldozer has been brought out by the Baker Manufacturing Co., 506 Stanford Ave., Springfield, Ill., for use with the Caterpillar 30 tractor. This Model 51 has a moldboard, 40 in. high and 80 in. wide, which can be lifted and lowered through a range of 28 in. and can be adjusted to cut 6 to 10 in. below the bottom of the tractor tracks. The moldboard is of heavy construction with deck plates forming a girder parallel with the ground. Both cutting edge and moldboard can be easily removed for replacement.

The moldboard is lifted and lowered by means of twin cylinders, one on each side of the tractor and directly connected to a lifting crank mounted on Timken roller bearings. The side or push beams are hinged to the ends of the tractor rear axle.



Model 51 Baker Bulldozer for Caterpillar 30

The bulldozer is powered by the most up-to-date hydraulic pump having ball bearing and herring-bone gears delivering 1,000 lb. per square inch.

Easily operated levers in the cab of the tractor permit instant positive control for raising or lowering the blade.

The New Blaw-Knox "Trukmixer"

After years of research and development the Blaw-Knox Co., 2003 Farmers Bank Bldg., Pittsburgh, Pa., has placed on the market a truck mixing unit which is not only designed for mixing but can be used as a closed type agitating body for conveying premixed concrete.

With the Blaw-Knox "Trukmixer" control of concrete mixing is removed entirely from the truck driver and automatic functioning of mixing, water control and discharge is provided.

The mixing drum is octagonal in shape, tapered on both ends and automatically reverses rotation during mixing, thus giving a true end to end mixing action. The blades within the drum are designed for most efficient mixing within a given time. These blades consist of flat steel plates, properly shaped and attached to the inside face of the drum. They are easily removed and replaced as units in short sections without having to rebuild the entire blade system.

Blaw-Knox Trukmixer

The measurement of water is entirely removed from the control of the truck driver. A forced feed automatic water supply system is used which can be set for the amount of free water to be deposited into the batch of concrete, and no more water can be placed in the batch than is actually specified. The water control is equally accurate, regardless of the position of the truck body at the time when the water supply is turned on. The water is distributed within the drum through a distributing pipe of large diameter, having four points of distribution; all sprays being amply protected from clogging. The distribution of water within the drum is also adjustable. The water supply tanks on the Blaw-Knox "Trukmixer" are carried beneath the chassis.

The discharge door is of the screw type which lends itself more easily to the control of the discharge. In the discharge of the concrete the operator controls the action of the drum from the discharge end, and the discharge is rapid and positive without pulsation.

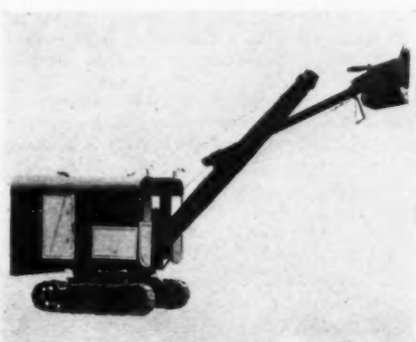
The transmission and other mechanical parts of the Blaw-Knox "Trukmixer" are made of the best materials obtainable and fitted in accordance with the best practice of automotive construction. All controls of the separate engine unit which actuates the mixer and control of water pump operation are accessible from the driver's seat.

Blaw-Knox "Trukmixers" are made in capacities of 2, 3, 4 and 5 cu. yd. for mixing, and from 2 to 8 cu. yd. for agitating pre-mixed concrete.

Improved Speeder ½-yd. Shovel

The Speeder Machinery Corporation, Cedar Rapids, Iowa, has announced recently improvements in the crawlers and driving mechanism of the Speeder Model B3 of ½ yd. capacity.

The new type crawlers and driving mechanism are designed especially to eliminate friction and to expedite the repair and adjustment of the traction shaft while on the job. The new crawlers are of the lug driven type, 16 in. in width and are hinged by three eyes. A roller idler now replaces the idler sprocket on the front of the crawlers. All crawler carrier trunnions and return rollers are bronze bushed. The traction shaft is splined and no keys are used. It is supported by four heavy bronze bushed split bearings, and is in three separate shafts, rather than one long shaft, which allows the man on the job to quickly remove any part for adjustment or repair. The travel gears are machine cut, heat treated, case hardened, and run in grease.



Speeder Model B3 with New Type Lug Driven Crawlers

The Speeder Whirlwind of ⅜ yd. capacity, the Speeder 90 of 1¼ yd. capacity, and the Speeder B3 of ½ yd. capacity are now equipped with crawlers and crawling mechanism of the same type.

New Portable Rock Crushing Plant

A portable rock crushing plant stated to be capable of handling 600 tons of rock in 10 hours with a 75-h. p. motor, has been developed by the Diamond Iron Works, Inc., Minneapolis, Minn. Rock to be fed to this plant is discharged from motor trucks into a large substantial steel hopper leading directly to the jaw crusher. From the jaw crusher it is discharged on a conveyor belt leading to the bucket elevator

New Portable Crushing Plant

where it is raised to a rotary screen which removes the dust and grades the rock into various sizes. Rock is then discharged into a jack leg bin, the over-size being returned to the roll crusher and from there dropped on the conveyor belt to be re-screened.

The plant consists of a 15 x 36-in. Diamond roller bearing crusher mounted on a heavy steel shaft fitted with Hyatt roller bearing wheels. The secondary 26 x 20-in. roll crusher is arranged to crush 2-in. stone or smaller. The rolls are fitted with removable manganese steel shells designed so as to be easily removed when they become worn.

The bucket elevator is furnished with a double-strand forged steel roller chain and electrically-welded steel continuous type buckets 18 in. wide by 10-in. projection by 11⅝ in. deep. The elevator is of the folding type and rests on top of the hopper

when being transported. It is raised into operating position by means of a ratchet crank operating on a worm and worm wheel hoist.

These plants are built in three sizes, No. 836, equipped with an 8 x 36-in. jaw crusher and 22 x 14-in. roll crusher; No. 1524, equipped with a 15 x 24-in. jaw crusher and a 26 x 20-in. roll crusher; and No. 1536, equipped with a 15 x 36-in. jaw crusher and 26 x 20-in. roll crusher.

The jack leg bins for these plants are built of heavy gauge steel and are electrically welded. They are provided with jack legs so that they can be easily raised to the proper height. The bins are made with one or more compartments with discharge gates to suit the requirements. They are well braced and of sufficient strength to carry a rotary screen. The standard sizes are 10, 15 and 21 yds.

A Conveyor for Placing Concrete from Transit Mixers

An apparatus to go on the back end of a transit mixer to carry the concrete and discharge it exactly where it is wanted has been developed by The Conveying Weigher Co., 90 West St., New York, N. Y., and Passaic, N. J. This conveyor can be swung sideways either way and lowered down practically to the ground. It also can be lifted to an angle of approximately 18 deg. and the concrete discharged over into forms 8 ft. higher than the ground level of the

End View of Swinging and Elevating Conveyor Attached to Mixer Showing Position for Sidewalk or for Roadwork

truck. It can discharge cement approximately 14 ft. backwards from the rear wheels of the truck.

The Conveying Weigher Co. has been working on this conveyor for a little over a year and has developed in the first place a belt made of a special fabric and covered with a rubber which is probably tougher than any composition of rubber ever known. The reason for the rubber is that the belt carrying the concrete leaves at its discharge point sticking to the belt small particles of sand and cement and water. The special squeegee made of the same compound as the cover of the belt is fastened to the underside of the belt and after it has gone around the head pulley every particle of fine material is stated to be taken off the belt. This has made necessary the special fabric which the company has designed and which perhaps comes more nearly to the fabric used in a cord tire so that the adhesion of the rubber and this fabric is such that it is next to impossible to tear the rubber cover away from the body of the belt itself. This belt in a great way is responsible for the success of this transit mixer conveyor.

The power of this conveyor is taken from a drive shaft or a countershaft just behind the driver's cab, which is the same shaft

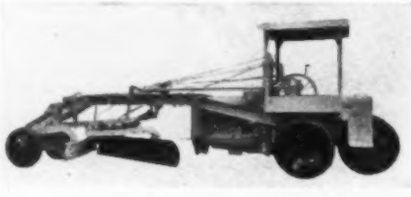
Side View of Conveyor

that is used to revolve the drum of the mixer. This shaft running back under the running board beside the revolving drum has on its way a high-grade friction clutch so that there is no possible chance of slipping at this point. At the back end of this shaft there is a high-grade roller chain with cut steel sprockets and the power is carried down to a horizontal shaft projecting back from the tail end of the machine. This horizontal shaft driving through cut gears and a vertical shaft and another horizontal shaft which acts as a pivot for the conveyor itself give the power to the pulley driving the conveyor. The proper steel skirt boards are placed on each side and the back end of the conveyor so that there is no spillage. By means of a frame fastened to the frame of the truck itself the discharge end of the conveyor is carried through ropes and sheaves up and over and down to a worm and worm gear easily accessible from the ground. After the mixer is unloaded the operator raises the discharge end of the conveyor up in the air. The conveyor remains in this position while the truck is on the road. No labor is required except one man to keep swinging around the discharge end of the conveyor or raising or lowering it to suit the place where he wishes the concrete to go. The baffle plate on the end of the conveyor is such so that in an instant it can be moved so that the concrete can go further away from the conveyor, or to chute straight down, or to be turned so that concrete can even be placed under the conveyor itself. Patents have been applied for covering many points on the machine.

A Multi-Wheel Power Grader

A road grader powered with a standard industrial tractor and equipped with a multi-wheel, giving added tractive power, has been announced by the Rome Manufacturing Co., Grader Department, Rome, N. Y.

This grader is powered with a McCormick-Deering No. 20 industrial tractor and equipped with a Rightway multi-wheel drive unit. The frame is an 8-in. I-beam weighing 25.5 lb. per foot, properly arched or bent to make it flexible enough to conform with the unevenness of the ground and yet make it rigid enough to withstand



Rome Multi-Wheel Grader

the strains and thrusts to which a motor grader is subjected. The frame is long enough so that both the scarifier and the blade can be operated at the same time without interference or clogging. The wheel base of the grader is 18 ft. 3 in.

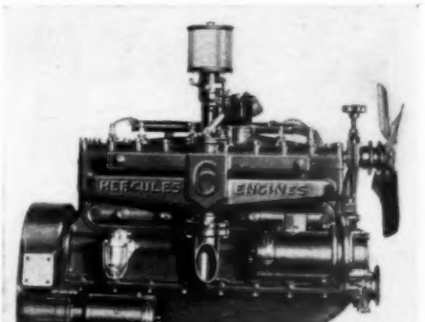
This tractor is designed with due thought for the ease and convenience of the operator—ease of handling, unobstructed vision, steering, controls within easy reach, etc. Timken bearings, counterbalancing springs, ball-and-socket joints, cut gears running in oil, and Alemite lubrication, all contribute to the ease of operating and steering this unit. The circle on the Rome multi-wheel motor grader is 66 in. in diameter and is made of high grade carbon steel heavily reinforced with three sections bolted together with spacers.

Hercules Builds Series of Small, Heavy-Duty Sixes

The Hercules Motors Corporation of Canton, Ohio, is offering an additional line of heavy duty, six cylinder "L" head engines designated as the "JX" series. This "JX" series is available in three different sizes, as follows:

Model	*Bore*	*Stroke*	*Displacement*
JXA	3⅜	4¼	228 cu. in.
JXB	3⅝	4¼	263 cu. in.
JXC	3¾	4¼	282 cu. in.

All three engines are identical in design and in installation dimensions. They differ only with respect to the bore and such parts and performance ability as are thus affected.



Manifold Side of Hercules "JX" Series Six

While the "JX" series is a strictly heavy duty line, all sizes are designed to meet present day needs and to withstand the stresses of high speed operation. Utmost simplicity, which is the foundation of all Hercules designs, is one of the outstanding features of these models. It is also interesting to note that the "JX" series six cylinder motors are companion models to the well recognized "OO" series of four cylinder engines. Many of the parts such as the connecting rods, timing gears, valve mechanism, etc., are interchangeable. Thus in cases where either small fours or sixes may be required extensive interchangeability features are provided in the "JX" and "OO" series.

The crankcase is cast integral with the cylinder block, assuring extreme rigidity and permanent alignment of bearings.

The Crankshaft is supported by seven main bearings, all 2½ in. in diameter. The total projected area of these bearings is 27 sq. in.—a high ratio of displacement to bearing area which reduces pressure per square inch of bearing, and combined with efficient lubrication, assures long bearing life.

New Heil Dump Unit

A new dump unit for light duty trucks has been announced by The Heil Co., Milwaukee, Wis. The "WB" unit consists of the following: a No. 1 Heil single cylinder hoist mounted in a channel iron supporting frame which fastens to the chassis frame with clips; a Heil power takeoff and connecting parts; an all welded steel body to be selected from the standard utility models listed in the "WB" catalog. The unit is shipped completely assembled ready for immediate mounting.

The No. 1 Heil Hoist is a full-fledged, quick acting, powerful, hydraulic hoist providing a 50° body dumping angle. The hoist pump is an integral part of the hoist and is operated by a Heil power takeoff attached to the truck transmission. Levers, conveniently located in the truck cab, control raising and lowering of the body.

New Erie Dragline Bucket

A new dragline bucket is being marketed by the Erie Steel Construction Co., Erie, Penn. Many new features are claimed by the manufacturer, for this bucket.

The bucket is stated to be suitable for every kind of dragline work. It is light in weight yet sturdy in construction. This is accomplished by improved design, thus eliminating all unnecessary weight. Perfect balance is a feature of the bucket. This is obtained by locating the center of gravity with relation to the hoist trunnion brackets so that at all stages of operation the bucket is well balanced. A light pull on the dump line holds the bucket in a carrying position and when released the bucket dumps quickly and freely.

The bucket is of rugged construction. Extra strength is built into the bucket where it will do the most good. For example—the bridge is built to keep the sides from pulling in. It ties in with the lip and side plates thus eliminating chances of failure at this common point of weakness. The hitch plates are heavy steel castings overlapped by reinforcing plates and angles and are interlocked with the base of the bridge and the ends of the lip. Corner connections are flanged to obtain the maximum of strength, thus providing for all possible strains when the bucket is in action. Rivets are used throughout and are machine driven. A one piece back band is tied into the bridge and welded and riveted to the side plates. This greatly adds to the strength of the side and end plates.

The drag chain is made up of electric welded links to give extra strength, and is provided with a socket for the drag cable and a guard to the fair-lead sheave. Alloy steel renewable reversible teeth and alloy steel heat treated lips are regular equipment of these buckets.

The bucket comes complete with chains ready for attaching to the dragline machine, and its performance, material and workmanship is guaranteed.

A four page circular describing and illustrating the bucket is ready for distribution by the Erie Steel Construction Co.

The Bullscoop

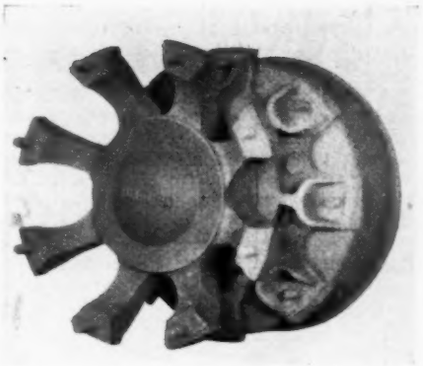
One of the interesting new tools exhibited at the St. Louis Road Show, was the Bullscoop on a "Caterpillar" Ten exhibited by LaPlant-Choate Mfg. Co. of Cedar Rapids, Ia. This tool derives its name from the fact that it is a combination of a scoop and a bulldozer. At the rear of the tractor is attached a scoop shaped like a shovel bucket with teeth which break up the soil and facilitate easy loading. This scoop is so designed that it is loaded and then lifts and carries its load to the point where it is to be deposited. After the load is dumped, the machine is equipped with a bulldozer attachment which enables the same outfit to bulldoze the material to position, level and pack it.

The Bullscoop with Bulldozer Attachment and Scoop

The entire Bullscoop may be quickly and easily attached, or detached. This Bullscoop is made in three sizes, namely, 16 cu. ft., 23 cu. ft. and 30 cu. ft., for "Caterpillar" Ten, Fifteen and Twenty tractors respectively.

New Dual Wheel for Trucks

A dual wheel that is stated to permit each tire to rotate independently and yet permit braking on both tires has been brought out by the Fuhrman Tractor Co., Canton, Ohio. By using two independent wheels each revolving on two Timken roller bearings, with an interlocking device that operates only when the brakes are applied it is possible to brake on both tires using only one brake drum, and yet eliminate all sliding or skidding of tires even on very short turns. This invention will also permit the use of dual tires on the front wheels of heavy trucks and busses.



Fuhrman Differential Dual Wheel

Changing tires is accomplished by mounting the outer rim on a removable ring which permits changing the inner tire and rim easier than has been possible with the present type of dual wheels.

Continental Announces Another New Engine

Deliveries are shortly to be made of another new series, in four sizes, of Continental 6-cylinder, L-head engines to be known as the E-600. This group, designed for high speed and performance, yet of comparatively low weight, in no wise supplants any of the company's present models, but on the other hand it provides an even more closely graduated series between the well known Model 16-C and the heavier R-series of overhead valve type.

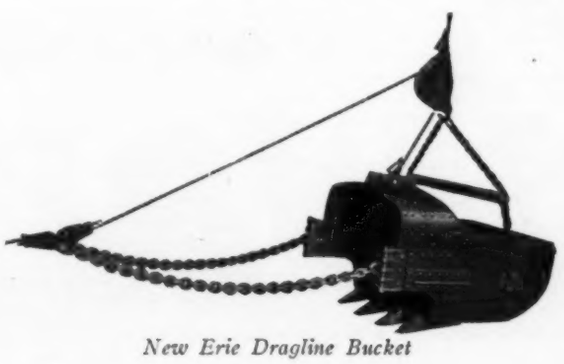
All of these E-600 are of 4½ in. stroke, but the bores are 3⅛ in.—3⅞ in.—4⅛ in.—and 4¼ in., with displacements of 288.3, 318.0, 360.7, and 382.9 cu. in. respectively. It is stated that several striking features of design in manifold, camshaft, and combustion chamber have resulted in a happy combination of unusually high torque characteristics over a wide speed range. At the same time the typical Continental strength and sturdiness have been coupled with low weight. Full provision has been made in the basic design for all the current accessories, such as oil filter, air cleaner, air compressor, etc. and for dual ignition.

New Dragline Bucket

A new dragline bucket has been brought out by the Northwest Engineering Co., Chicago, Ill. It is stated that through scientific design and the use of special alloy steels, a bucket of enormous strength and unusually light weight has been developed.

The outstanding difference in the Northwest dragline bucket is in the arch. This is an I-beam section, a sturdy casting. The hitch is so placed that blows from striking the bank are taken on the arch and not on the side plates. The lip differs from the usual casting in being of rolled alloy steel. This is welded directly to the arch and the two are heat-treated as a unit.

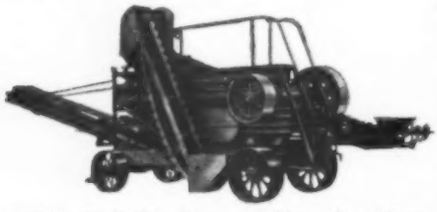
The basket or load-carrying portion is formed from a single piece and welded at the corners. This makes a clean smooth interior. The dumping sheave has received special attention and is designed to promote maximum cable life. The dump sheave and hoist trunion pins are of hardened steel and all castings are heat-treated.



New Erie Dragline Bucket

A Double-Unit Crushing and Screening Plant

A plant primarily designed to reduce pit run gravel to ¾ in. material without sacrificing capacity and portability, has been placed on the market by the Diamond Iron Works, Inc., Minneapolis, Minn., in its No. 60 double-unit crushing and screening plant. This portable plant has two crushers, an 8 x 36-in. roller bearing jaw crusher for the primary and 22 x 14-in. rolls for reduction. These are mounted in one compact portable unit.



Double-Unit Crushing and Screening Plant

The shaker screen which is hung in ball bearings has an upper screen with 2-in. perforations and a lower screen with openings the size of material desired. The pit-run over 2 in. goes to the primary crusher and all under 2 in. and larger than the perforations to the secondary crusher.

To avoid unnecessary strains when moving the plant from one pit to another a 3-point suspension is used. The star gears driving the rolls run in oil in an oil-tight gear case. If conditions make it desirable these rolls can be disconnected and the plant used as a single unit machine. The entire plant is electrically-welded, no rivets being used in construction.

General Motors Adds Two New Heavy Duty Trucks

Two new heavy duty models in the 4 to 5½ ton range, alike except in rear axle design, have been added to the General Motors Truck Co. line.

Both rear axles are full floating. In Model T-51 it is spiral bevel gear type, and in Model T-55 it is double reduction type.

Primary reduction in the rear axle of Model T-55 is through spiral bevel gears; secondary reduction through herringbone gears. All gears are mounted on anti-friction bearings. In both models, axle shafts are of chrome molybdenum steel, two inches in diameter. Housings are malleable iron.

The trucks are powered by the General Motors Truck 6-cylinder, 94-h. p. engine.

Frames of the T-51 and T-55 are 9 in. deep, pressed from steel $\frac{9}{32}$-in. thick. Flanges are 3½ in. wide and there are 5 or 6 strong cross members, depending on wheelbase length. The exclusive GMT stress absorber is an added feature of the frames.

Springs match other parts in sturdiness and ability to provide proper riding qualities under all load conditions. Rear springs are 50 in. long with 11 leaves and have auxiliary springs 35 in. long with seven leaves. Front springs are 40 in. long with 12 leaves.

Both models have 4-speed transmission of sliding gear type with all gears of pack-hardened, 5 percent nickel steel. The clutch is simple, durable disc type, mounted in fly-wheel housing on ball bearings. Driving discs are of heavy cast iron for dissipating heat.

Four-wheel brakes and roller bearing, worm type steering gears are provided.

New 15-Ton Crawler Wheels

New 15-ton crawler wheels designed for mounting on various types of wagons used for heavy hauling are now in production by the Trackson Co., Milwaukee, Wis. Several sets of Trackson crawler wheels were introduced about two years ago and have been in operation ever since. The new wheels, however, are even stronger and simpler in construction. Heavier tension members of the single strand type are used in the new model, replacing the double strand type which was formerly used. These tension members are easily renewed, independently of the track shoes, when worn, which is also true of the hinge-pin bushings.

Changes in the new Trackson crawler wheels include full-floating pin construction. Solid bushings are now employed instead of the former split type. Improved Timken bearings with cork dust seals are used in the new crawler wheels, and the frames have been made much heavier to withstand strains and side stresses.

New Trackson 15-Ton Crawler Wheels

Shoes for the 15-ton wheels can be furnished in two widths, the 17-in. width for use on 5 and 7-yd. cart type wagons, and the 19-in. for use on heavier wagons.

New Front-Spring Rocker for Tractors

Introducing an entirely new principle in front spring mounting design, the Hug Co., of Highland, Ill., manufacturers of road building trucks and equipment, has just announced and put into production on its roadbuilder trucks a newly patented device known as the Hug front spring rocker. The rocker is made up of an assembly consisting of a special cross member or rocker bar attached to the rear ends of the two springs by means of double-action spring shackles. The cross member is in turn connected in the center to a special U-type rocker bar equalizer, thus allowing the front axle to rock under the frame without twisting or distortion.

The chief advantage of the front spring rocker, lies in its application to trucks operated over uneven roads and more particularly to trucks used in excavation and road building. The use of the rocker is claimed to eliminate twisting, bending or breaking of frame rails; breaking of motor supports or hangers; or twisting of cab, radiator or hood. The new device, an exclusive Hug feature, was developed by C. J. Hug, president of the company, and his staff of engineers, after a number of years of exhaustive experimentation, plus Mr. Hug's many years' experience in road-building, prior to his entry into the truck field.

New ⅜-Yd. Convertible Excavator

A new ⅜-yd. excavator has been announced by the Harnischfeger Corp., Milwaukee, Wis. This new machine, known as the Model 200-A, follows the same general design of the larger P&H's. It is sturdily and compactly built with a large proportion of alloy steels and is light enough to meet the demand for a convertible excavator weighing under 14 tons. Hoist, swing, crowd, and travel speeds are unusually fast.

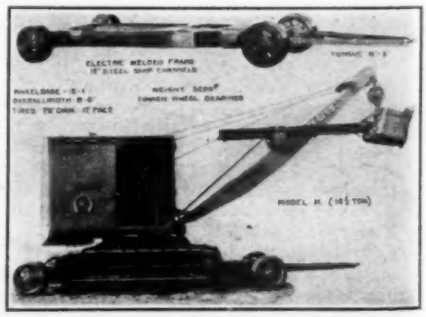
The crawlers employ the well-known P&H double sprocket drive on link pins. All machinery on the revolving frame is placed with a view to compactness but with full accessiblity. Drums are mounted on separate shafts with the jack shaft assembly between. The entire gear train is located on the right side of the machine and runs in an oil bath. Shafts operating in excess of 40 r.p.m. are roller-bushed. All clutches are of the internal expanding type. Hoist and crowd clutches are interchangeable, as well as the five main outside type brake bands.

A 4 or 6-cylinder 45-hp. gasoline engine furnishes power. The patented P&H chain crowd appears on the Model 200-A in a highly perfected form. The P&H Model 200-A shovel is standard with a 17-ft. boom and 12-ft. dipper sticks giving a total dumping height below door of 17 ft. The dragline and crane booms are of lattice box section design with a standard length of 30 ft. The machine is fully convertible for shovel, dragline, clamshell-crane, trench-hoe, or skimmer-scoop operation.

New Trailer for Conveying Shovels

A new 4-wheel trailer has been developed by Bay Shovels, Inc., Bay City, Mich., primarily for the purpose of carrying its ⅜-yd. tractor shovels (10-ton weight), as well as its Model K revolving shovel (14½-ton weight). The trailer is constructed with a sturdy electric welded frame made up of 12 in. steel ship channels. The wheel base is 15 ft. 1 in. and over all width 8 ft. making it possible to use this trailer on all state highways without special permit. Tires are 28 in. diameter, 12 in. face. Heavy-duty rubber tire wheels are equipped with Timken bearings.

It is stated that Bay City shovels can be loaded on this trailer in 8 minutes time. The trailer can be used for handling any other shovels, cranes or contractors equipment up to 14 tons in weight. While developed primarily to provide Bay City machine owners with a low priced trailer for their Bay City equipment, the sale of it will not be limited to Bay City owners.



New Bay City Trailer

ORD FINISHER

averaged 1000 lineal feet of 18 ft. "water-cement ratio concrete" road per day.

Yoakum, Texas
Nov. 28, 1930

"The ORD Machine we have, has finished 32 miles of 18′ concrete highway in the past twelve months. The results obtained have been entirely satisfactory and the machine has been able to keep up with the finishing with ample to spare even though at times we poured as much as 1400 lin. feet per day over a period of several weeks. About 14 miles of this work was "water-cement ratio concrete" the mix being very dry and the machine performed satisfactorily, averaging 1000 lin. feet per day."

INTERSTATE CONTRACTING CO.
W. L. Bullock, Mgr.

Learn more about the dependable ORD for concrete and asphalt roads—ask

BLAW-KNOX COMPANY
2003 Farmers Bank Bldg., Pittsburgh, Pa.
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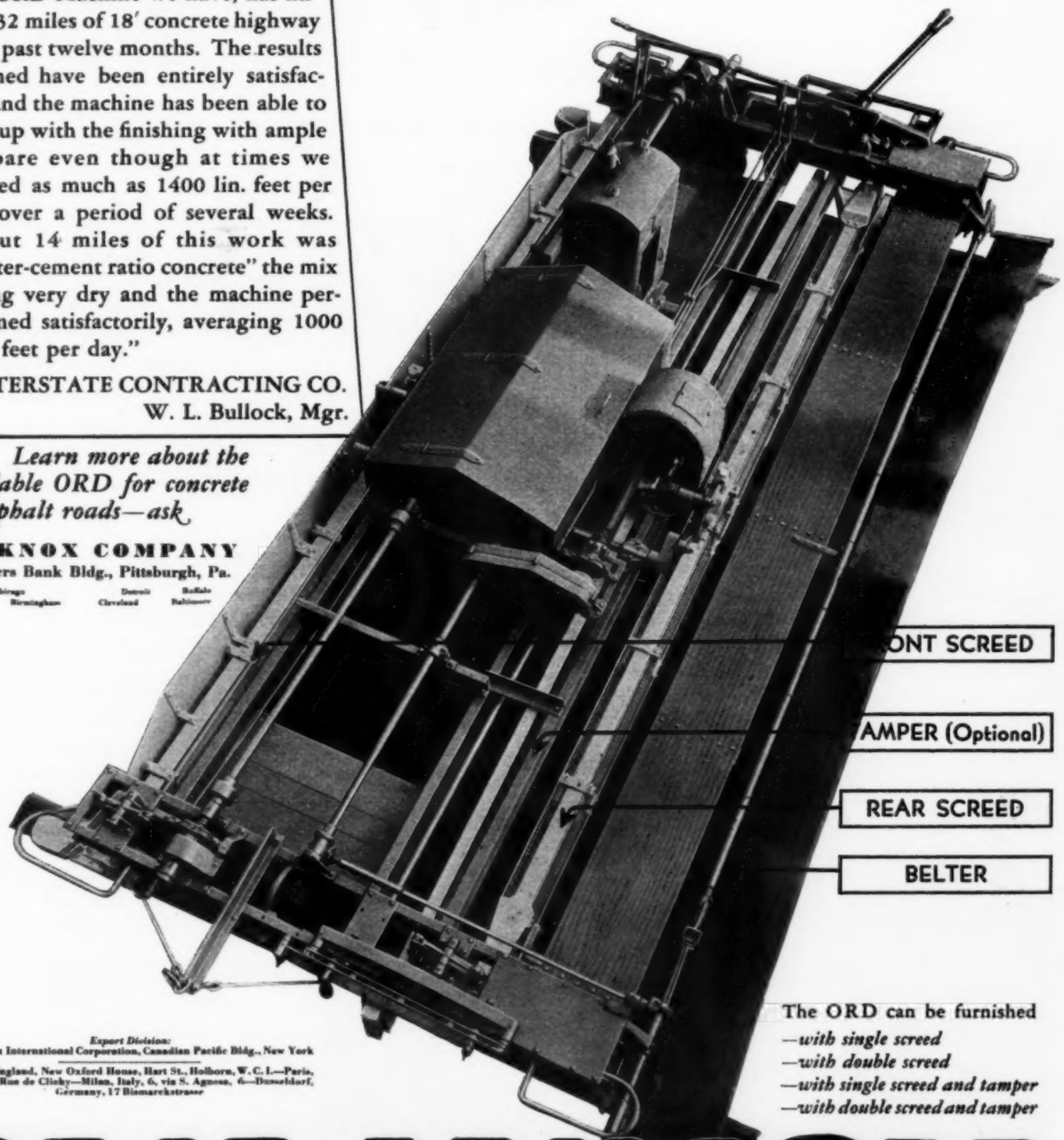


The ORD can be furnished
—with single screed
—with double screed
—with single screed and tamper
—with double screed and tamper

Export Division:
Blaw-Knox International Corporation, Canadian Pacific Bldg., New York

London, England, New Oxford House, Hart St., Holborn, W.C. 1.—Paris, France, 1 Rue de Clichy—Milan, Italy, 6, via S. Agnese, 6—Dusseldorf, Germany, 17 Bismarckstrasse

BLAW-KNOX

Road Forms Ord Road Finishers Batcherplants Weighing Batchers Volume Batchers The Cementank Bulk Cement Plants Wagon Graders Steel Forms for Streets and Sidewalks
Truck Turntables Nu-Method Finish Grader The Inundation System Clamshell and Dragline Buckets Ready Mixed Concrete Plants Truck Bodies

Distributor News

Bond Company Holds House Warming

The Bond Company of Boston, of which Mr. Harold Bond is president, recently moved into their new building at 39 Old Colony Avenue, South Boston.

This company now has what is said to be the largest and most modern display room for construction equipment in New England. In celebration of their increased facilities and improved methods for serving the trade in their territory, they held a house warming and invited all their friends to join with them in a day given over to motion pictures, music, refreshments and an exhibition of display room and warehouse. The entire sales force acted as hosts to the visitors.

Harold L. Bond has been engaged in the contractors' supply business since 1887, and began business on his own account in 1901. The present company was organized in 1923 and until moving into their new headquarters were located at 84 High Street, Boston. Mr. Bond has associated with him his two sons, Harold C. and Lowell. The former is treasurer of the company and is well known throughout the trade as he has been identified with this line of business for the past twenty years. Lowell Bond has a wide circle of friends in the trade, as he has been engaged in selling contractors' equipment since his return from the war.

The company is well qualified to give satisfaction to the New England territory, for through long experience they have built up their business with prompt service, quality of equipment, fair prices and fair treatment.

As New England distributors, the company represents The National Equipment Corporation comprising the Koehring shovels, pavers and dumptors, the Smith concrete mixers, the Insley machines, etc.; Rogers Brothers Corporation, trailers; Novo Engine Company, gasoline engines, pumps and hoists; C. S. Johnson Company, batchers and bins; Chicago Automatic Conveyor Company, portable belt conveyors; and many other well known kinds of standard equipment.

Mr. Bond reports that the outlook for business in their line this year, is on the whole encouraging, although he states it has been quiet during the past few months.

A Glimpse Into the Bond Warehouse

Toronto Company to Make Bay City Shovels

Arrangements have been completed between Bay City Shovels, Inc., of Bay City, Michigan, and the John Inglis Co. Ltd. of Toronto, for the manufacture of the complete line of Bay City machinery in Canada. It is reported that orders have been placed with the Inglis company for the construction of a number of shovels, and work will begin on the tractor model shovel as soon as materials can be procured. As soon as this type of equipment is under production, work on the larger full revolving models will follow. During the time required to get into production partly completed models will be shipped from Bay City to Toronto where final assembly and delivery will be made. It is stated that all models will be manufactured in Canada as soon as possible.

Bay City Shovels, Inc., are makers of six different types of convertible power shovels, cranes and excavators. The equipment will be sold in Canada through the same distributors who have formerly represented the Bay City products, under the supervision of the home office.

Bucyrus-Erie to Manufacture Loadmaster Crane

Bucyrus-Erie of South Milwaukee has taken over the manufacture and sale of the Loadmaster revolving boom crane formerly sold by Frederic H. Poor, Inc., New York City, according to recent announcement.

This machine has many uses and its extreme mobility and ease of handling makes it adaptable for public utilities, railroads, industrial plants, pipe line constructors, foundation or construction work, airports, seaplane bases, etc.

New Branch Facilities for Allis-Chalmers

A new factory branch has been opened at Dallas by the Allis-Chalmers Manufacturing Co. It is located at 3612 Commerce Street.

R. S. Love is branch manager. In addition to agricultural tractor and implement sales, he will also have charge of industrial tractor sales, including Monarch track type tractors and model "U" industrial models.

The Allis-Chalmers branch at Kansas City is now handling both agricultural and industrial sales also. This branch, which formerly distributed only the agricultural line, was recently moved to larger quarters at 1608-14 McGee Street.

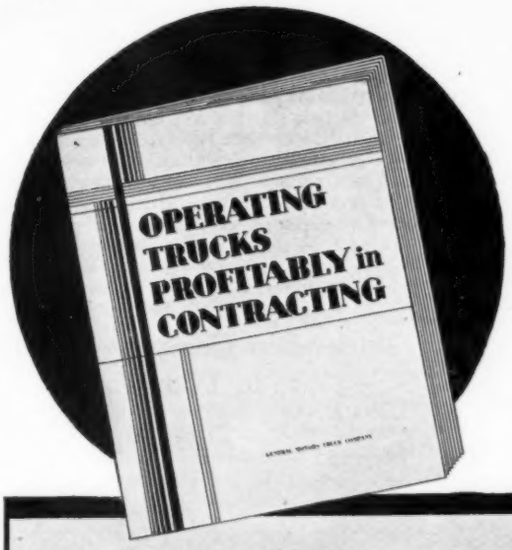
O. J. Thomas, for several years branch manager for Allis-Chalmers at Wichita, is now manager at Kansas City. C. E. Pickens is assistant manager in charge of agricultural sales and L. M. Smith is assistant manager in charge of industrial sales.

The Pennsylvania-Dixie Cement Corporation, New York City, has announced the advancement of H. B. Springer to the position of manager of contract sales with headquarters in New York.

Clark P. Brown succeeds him as district sales manager in charge of Penn-Dixie's Philadelphia sales office.

Chain Belt Company of Milwaukee has moved its Buffalo, New York office from 753 Endicott Square to 1807 Elmwood Avenue. T. E. Cocker is district manager in charge of the Buffalo office.

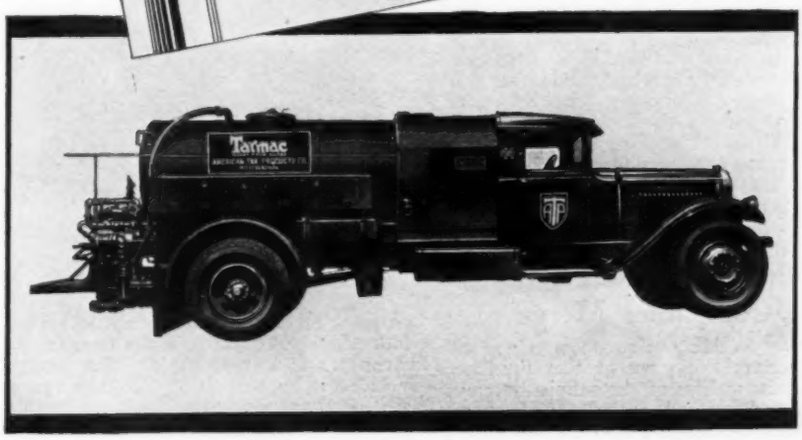
"Pleased to Meet You"
Left to right, Back Row: Charles H. Tucker, J. P. McElroy, (N. E. C.), Donald West, J. B. Colby, Eugene Piazzo
Middle Row: H. C. Bond, Harold L. Bond, president; Lowell Bond
Lower Row: A. F. Wakefield, J. L. McKeon, M. F. Hall



"Puts Spotlight on Points where Drains on Contractors' Profits Occur"

—ROADS AND STREETS

April Issue



IN reviewing this impartial survey report of a nation-wide study of truck operation in contracting, the April issue of ROADS AND STREETS states:

" 'Operating Trucks Profitably in Contracting', is the title of a well prepared booklet published by the General Motors Truck Company. It is really a report on the economics of truck operation in two types of business. The first part discusses the problem of hauling from the material dealer's point of view.

"The latter part is devoted, aside from some strictly equipment discussion, to a thorough analysis of the general contractor's hauling problems. Examples are given as to how to calculate truck supply. They are taken from actual construction work observation.

"As this report brings out, a truck is simply a transportation tool and as such should be kept up to a high standard of operating efficiency. Many points are discussed in this booklet, which will help the construction superintendent to keep his hauling units going at the maximum of efficiency. "Planning and scheduling deliveries to prevent delays on the job is a fundamental factor in successful contracting. This report tells how this can be obtained."

The facts disclosed by this survey have helped equip General Motors Truck representatives to cooperate effectively with the road-building contractor in making his truck operation more profitable—in applying new equipment *exactly suited to the job.*

The survey itself has placed in the hands of our engineers a valuable fund of knowledge on the specific requirements of truck design and construction demanded by the operating problems of your industry.

Now, more than ever before, modern, 6-cylinder General Motors Trucks offer contractors today's outstanding VALUES—General Motors Values!

Mail the coupon for your free copy of this survey-report on contracting. No obligation.

GENERAL MOTORS TRUCK COMPANY,
Dept. 307, Pontiac, Mich.
Gentlemen: Please send, without cost or obligation, a copy of "Operating Trucks Profitably in Contracting."

Name.....

Address.....

GENERAL MOTORS GM TRUCKS

A PRODUCT OF GENERAL MOTORS

GENERAL MOTORS TRUCK COMPANY, Pontiac, Mich.
(*Subsidiary of* Yellow Truck & Coach Mfg. Co.)
GENERAL MOTORS TRUCKS, YELLOW CABS and COACHES.
Factory Branches, Distributors, Dealers—in over 2200 principal cities and towns. (*Time payments financed through our own* Yellow Manufacturing Acceptance Corporation *at lowest available rates.*)

Yes—we would like you to mention ROADS AND STREETS.

H. G. Chandler Joins Havana Metal Wheel Company

C. J. Goshert, Secretary and General Manager of Havana Metal Wheel Company, announces the appointment of H. G. Chandler as manager of the company's sales promotion work. The appointment is already in effect and Mr. Chandler is now handling the duties of his new position.

Mr. Chandler has a wide acquaintance among the implement trade through many years of service with the former Hart-Parr Company of Charles City, Iowa. He was Northwest divisional sales manager for that firm at the time it became a part of the Oliver Farm Equipment Company. Since then he has been active in branch organization work for Oliver at its Minneapolis and South Bend branches.

H. G. Chandler, Sales Promotion Manager, Havana Metal Wheel Company

His recent appointment is part of a new program of Havana Metal Wheel Company which will bring to its customers a closer personal contact and better sales service in the future. Mr. Goshert states, the company's manufacturing facilities are also being extended by the addition of new equipment which will better enable them to handle quantity orders for heavy duty tractor and combine wheels as well as all other types of metal wheels for every purpose.

Metalweld Names Some New Distributors

Garlinghouse Brothers, one of the foremost equipment houses on the West coast, has been appointed to represent Metalweld, Inc., of Chicago and Philadelphia, manufacturers of portable air compressors. The Garlinghouse brothers, Messrs. L. H. and A. F., respectively, are graduates of Rensselaer Tech, and have made an enviable record in Southern California. They are located at 2044 Santa Fe Avenue, Los Angeles. They represent such well-known lines as Blaw-Knox, Browning Crane, McKiernan-Terry, Lidgerwood, Telsmith, Insley, Knickerbocker and Leschen.

The San Francisco territory, formerly cared for by the local Worthington branch, has been assigned to Taylor & George.

In the East Metalweld has granted exclusive selling rights for a number of counties in central Pennsylvania to the Gleason Motor Car Company of Shamokin, Pa.

Hall Made Boston Manager Sullivan Machinery Co.

The Sullivan Machinery Company announces the appointment of Edwin T. Hall as manager of its Boston office, succeeding the late George H. Richey.

Mr. Hall has been associated with Mr. Richey in the New England sales district of the company for the past fifteen years.

Distributor Notes From Gardner Denver Co.

The Gardner-Denver Company has recently appointed the Wm. T. Walsh Equipment Company, Cleveland, Ohio; the Virginia Tractor Company, Inc., Richmond, Virginia, and C. F. Rabbeit, Inc., of St. Louis, Missouri, as distributors for their line of portable air compressors, rock drills, paving breakers, spaders, sharpeners, and other equipment for the road-building and construction industries.

Pioneer Pacific Coast Companies Merge

Victor Welding Equipment Co., with headquarters and plant at San Francisco, California, makers of the nationally known Victor welding and cutting equipment and the Kimball-Krough Pump Co. with plants at Los Angeles and San Francisco, have been merged into the Victor Equipment Co. Both Victor welding equipment and Kimball-Krogh pumps will continue to be sold under their trade marks and the two original companies will be operated as individual divisions by the newly formed Victor Equipment Co.

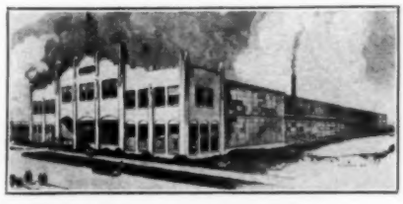
The object of this merger is to strengthen the engineering and research facilities; to enlarge the domestic and foreign sales fields; to consolidate and expand warehousing, trucking, and delivery service. A considerable reduction in overhead expense is anticipated because of unified management, co-ordinated advertising, and the utilization of the combined engineering skil lof the newly formed company.

Since 1877 pumps of the Kimball-Krogh division have been marketed internationally, and Victor Welding Equipment has been a pioneer of a new industry which today has become one of the largest in America and without which, it is said, the construction of modern pipe lines, construction or dismantling of ships, maintenance of frailroad equipment and tracks, repair of broken machinery, design of modern steel structures, would have been impossible.

The Victor Equipment Co. will be under the management of the men who have contributed so materially to the splendid development of the two companies involved in this merger. Mr. L. W. Stettner as president will be assisted by Mr. E. L. Mathy as vice-president in charge of sales promotion and advertising, Mr. Geo. Pennington as vice-president and general manager of the Kimball-Krogh division, Mr. Ronald Schlegel as vice-president and assistant to Mr. Pennington, and by Mr. Wm. Fulwider, secretary, in charge of accounting.

Butler Bin Company Adds to Plant

The Butler Bin Company have recently enlarged their plant at Waukesha, Wisconsin, by a substantial addition increasing their capacity approximately 50%. Beside adding to the shop area, space has been



Headquarters of Butler Bin Co.

provided for a new and modern tool room, with additional capacity in the template department and drafting room. Other changes include the installation of a modern system of general and private offices.

The Butler Bin Company manufacture steel storage bins, weighing and volume measuring hoppers, bin gates, etc.

Link-Belt Company Increases Directorate

Under recent amendment of the Link-Belt Company charter, three additional members have been elected to the board of directors of this company, thus increasing the number of board members to twelve. No change was made in the members of the directorate serving previous to the stockholders' meeting at which the new members were elected.

The new members are: Arthur L. Livermore, attorney, New York City; George P. Torrence, vice-president of the company in charge of the Indianapolis plant and Richard W. Yerkes, secretary and treasurer of the company.

Mr. Torrence, a graduate of Purdue University, joined the Link-Belt organization at Indianapolis in 1911, and after advancing to the position of general manager of sales at the Chicago plant, he was made vice-president in charge of all Indianapolis plant operations.

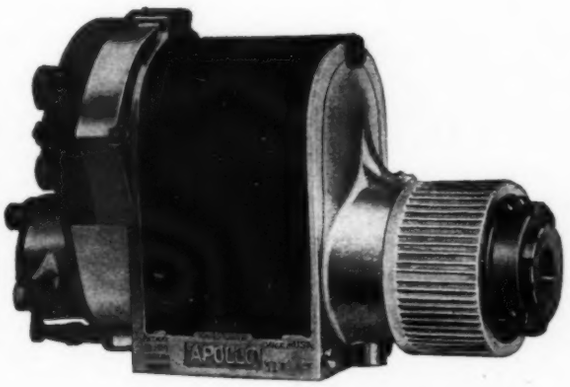
"They Chase Dirt"

The Department of Public Works of Philadelphia has recently purchased a fleet of Dodge three-ton heavy duty trucks, for the street cleaning bureau. It is said, in return for the rough, hard treatment given this equipment by the Quaker City street cleaning department, it gives in return the best of service.

APOLLO IGNITION PRODUCTS

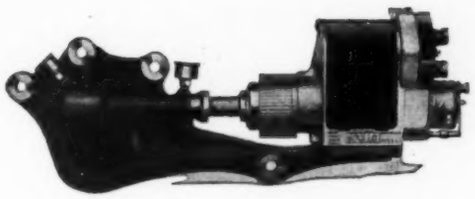
Manufactured by

APOLLO MAGNETO CORPORATION
KINGSTON, NEW YORK

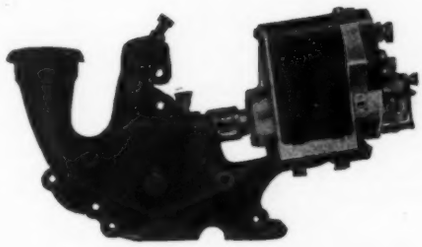


Apollo Magnetos, with or without Impulse Couplings, are furnished in 2-cyl., 3-cyl., 4-cyl., and 6-cyl. types. The Apollo, a dependable Magneto, developes a hot spark, which explodes all the gas, starts the motor easily, and saves in gas and oil consumption.

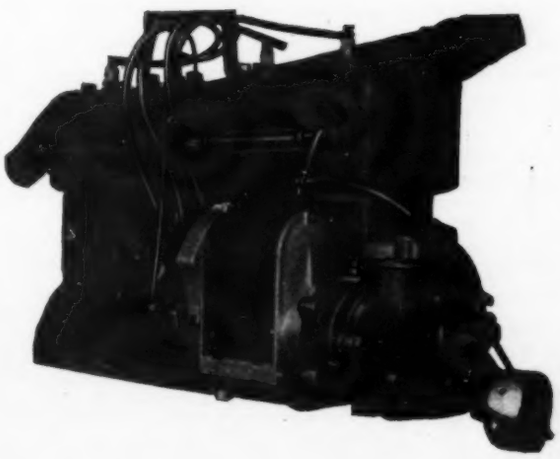
Apollo Impulse Starters are furnished with special catch plates to fit all types of standard high tension Magnetos.



Jumbo Attachments, furnished with or without the Apollo Magneto, for installing any standard make 4-cyl. right hand high tension Magnetos on Fordson Tractors. Easily installed in place of the original ignition system.



Columbo Attachments, furnished with or without the Apollo Magneto, for installing any standard make 4-cyl. right hand high tension Magnetos on all types model T Ford cars.



Fordo Attachments, furnished with or without the Apollo Magneto, for installing any standard make 4-cyl. right hand high tension Magneto on model A or model T Ford car (late types) in place of generator.

Fordson Tractors and Ford cars, when equipped with Apollo high tension magneto ignition system, will start easily, develop more power, and save in gas and oil consumption.

Special prices to manufacturers and contractors quoted upon request.

Moon Track Expands

The Moon Track Company, manufacturers of semi-crawler tracks for McCormick-Deering tractors, has established a

R. W. Moon, Vice-President and General Manager, The Moon Track Company

separate industrial division at the Chicago office. R. W. Moon, vice-president and general manager, states that this move was made to take care of the increasing demands from manufacturers, distributors and contractors for Moon tracks.

The first public showing of this equipment was at the Road Show in St. Louis.

H. W. Butler to Represent Butler Bin in East

The Butler Bin Company of Waukesha, Wisconsin, announces the appointment of Mr. H. W. Butler of Rochester, N. Y., as Eastern field representative and sales manager.

Mr. Butler's previous experience as general superintendent for Whitmore Rauber & Vicinus of Rochester, N. Y., gave him experience that eminently fits him for the duties he assumes as they embraced general contracting, material handling and central mixing plant operation. Mr. Butler will travel in the East contacting the various Butler Bin Company distributors in that territory and assist them in their sales efforts on Butler equipment.

Marvin Appointed Hercules Advertising Manager

Announcement has been made by Russell H. Dunham, president of Hercules Powder Company, of the appointment of Theodore Marvin as advertising manager. Mr. Marvin, who has been assistant advertising manager and editor of The Explosives Engineer magazine, assumes the post left vacant by the death of Nelson S. Greensfelder.

Mr. Marvin is a graduate of the Colorado School of Mines and has been associated with the Hercules company for eight years. He has been active in both the advertising and technical publicity fields and is the author of handbooks on mining and tunnel methods.

Here and There

The Cuyahoga Equipment Company of Cleveland, Ohio, held a sales school recently and about forty dealers and prospects under the direction of William Clark, general manager of the Cuyahoga company, journeyed to Bucyrus for instruction and to view an equipment exposition. They were addressed by department heads of the W. A. Riddell Company, including R. S. Spencer, G. D. Schaeffer, C. A. Genneuse and others.

The Heil Company of Milwaukee, announces the appointment of Harris, Young and Harris, Inc., Ft. Wayne, Indiana, as distributors for their products in that state and in southern and western Ohio.

Smith-Booth-Usher Company, the Los Angeles equipment firm located at 228 Central Avenue, is at present leading the group of contestants in the Schramm Air Races.

Dependable Highways for April, the monthly publication of the National Paving Brick Manufacturers' Association, presents a paper by R. J. Darnell on "Brick Pavements in Huntington, West Virginia," which was delivered by Mr. Darnell at the 25th annual meeting of the brick manufacturers' association. Mr. Darnell is assistant city engineer of Huntington, and has written a number of articles on highway construction.

Auburn S. Cunningham, sales manager of the Cuyahoga Equipment Company of Cleveland is the author of a text book on political history of America which is in use in public schools and libraries. The title of the history is "Everything you want to know about the Presidents.'

A most attractive and interesting house organ has recently made its appearance under the title *Interaco News*. It is published monthly in the interests of better street and highway paving by the Interstate Amiesite Company, Ind., Wilmington, Del. The "Roadetorials" contain some worth-while information and much common sense.

At a recent meeting of the Board of Directors of The Heil Company of Milwaukee, Joseph F. Heil was elected vice-president and director. "Joe" Heil, as he is familiarly known, is also treasurer of the Milwaukee Air Power Pump Company, a subsidiary of The Heil Company.

New Affiliations

D. J. Wilber, formerly divisional sales manager, and John H. Mayforth, a district sales manager for the Robert Bosch Magneto Co., are now connected with the Scintilla Magneto Co., Inc., Sidney, N. Y., which is a subsidiary of the Bendix Aviation Corporation.

The Timken Steel & Tube Company, Canton, Ohio, announces the appointment of Walter H. Wiewel as sales manager, to replace A. J. Sanford, resigned. Mr. Wiewel has been associated with the company for several years as manager of steel sales in New York City. He will make his headquarters at Canton.

Traylor Engineering and Manufacturing Company of Allentown, Pennsylvania, announces the removal of its New York office from 30 Church Street to the Empire State Building. This office is under the direction of R. R. Shafter.

Freystadt-Juraschek, Inc., formerly at 17 East 49th St., New York City, recently moved to new quarters in the R. C. A. Building, 570 Lexington Ave.

Announcement

The Service Supply Corporation, 20th and Venango, St., Philadelphia, announce the organization of a new division under the trade name of "Good Roads Machinery Sales Company." L. E. Walker, formerly branch manager for the Good Roads Machinery Company, will be in charge of the new division, handling the complete line previously sold by that company.

Williams to Represent Trackson at Columbus

The Trackson Co., Milwaukee, Wis., announces the appointment of W. W. Williams Co., 835 W. Goodale St., Columbus, Ohio, as a new distributor for Trackson tractor equipment. This distributor will handle the complete line of Trackson crawlers, shovels, hoists, cranes, bulldozers, etc., as well as a stock of repair and replacement parts for these machines.

Nelson S. Greensfelder

The industrial field was greatly shocked to learn of the passing of a nationally known authority on industrial advertising in the announcement of the death of Nelson S. Greensfelder, advertising manager of the Hercules Powder Company on April 5th, at Wilmington, Delaware.

The end came suddenly after a short illness which developed into pneumonia. He was survived by his widow, Grace Gleason Greensfelder, and a seven-year-old son, Robert J., and by his parents, Judge and Mrs. J. B. Greensfelder, Kirkwood, Missouri.

Mr. Greensfelder was born in St. Louis County, Missouri, March 20, 1891. He attended Colorado College and later graduated from the Colorado School of Mines, graduating in 1913 as an Engineer of Mines. He entered the employ of Hercules Powder Company as a salesman and demonstrator and upon showing ability as a writer and advertiser was transferred to the Wilmington offices, and in 1924 became advertising manager.

He was one of the organizers of the National Industrial Advertisers' Association, and as president represented this organization at the world advertising institute in Berlin, Germany, in 1929.

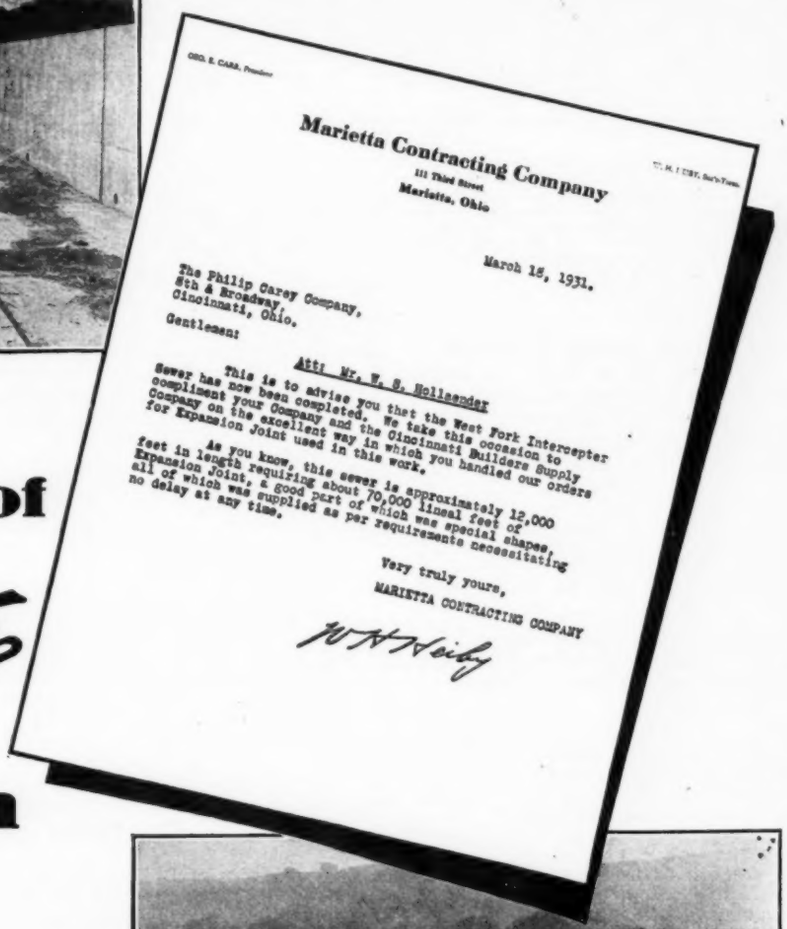
Mr. Greensfelder through the Explosives Engineer sponsored safer and better methods of using explosives, and was instrumental in instituting the National Safety Competition, a safety movement which under the U. S. Bureau of Mines, has done much to reduce industrial accidents.

He took an active interest in the American Mining Congress, American Institute of Mining & Metalurgical Engineers, National Crushed Stone Association, National Safety Council, Pine Institute of America, Institute of Makers of Explosives and Association of National Advertisers. Locally he was active in the Wilmington Chamber of Commerce, Boy Scout Movement, several clubs and the Masonic order. Burial was from his parents home in Kirkwood, Missouri.

George H. Richey

Through Arthur E. Blackwood, president of the Sullivan Machinery Company, announcement was made of the accidental death on April 1st of George H. Richey, manager of the company's Boston office.

Mr. Richey has been a member of the Sullivan organization since 1912, and manager of its New England sales office in Boston since 1919. He is survived by a widow and two children. His home was in West Medford, Mass.



Marietta Contracting Company
111 Third Street
Marietta, Ohio

March 16, 1931.

The Philip Carey Company,
5th & Broadway,
Cincinnati, Ohio.

Gentlemen:

Attn Mr. W. S. Hollaender

This is to advise you that the West Fork Intercepter Sewer has now been completed. We take this occasion to compliment your Company and the Cincinnati Builders Supply Company on the excellent way in which you handled our orders for Expansion Joint used in this work.

As you know, this sewer is approximately 12,000 feet in length requiring about 70,000 lineal feet of Expansion Joint, a good part of which was special shapes, all of which was supplied as per requirements necessitating no delay at any time.

Very truly yours,
MARIETTA CONTRACTING COMPANY

W A Weidy

70,000 feet of Carey Elastite Expansion Joint

"No delay at any time"

Here is another outstanding example of concrete construction—an interceptor sewer 12,000 feet long. Although the Expansion Joint had to be cut to special size, Carey Elastite Joint was delivered as required and on short notice.

Important concrete construction requiring Expansion Joint is almost always protected by Carey Elastite Joint, because the quality of the material and the certainty of its prompt delivery have been proved by 20 years of experience.

A nation-wide organization of distributors, carrying large stocks, insures that any order for standard or special sizes can be delivered on the job in the shortest possible time.

Write for 1931 Price List and Trade Discounts.

THE PHILIP CAREY COMPANY × Lockland, Cincinnati, Ohio
Branches in Principal Cities

BUILT-UP ROOFS
ASPHALT PRODUCTS
ELASTITE EXPANSION JOINT
WATERPROOFINGS
ROOF PAINTS

Carey PRODUCTS

HEAT INSULATIONS
ASBESTOS MATERIALS
CAREYSTONE CORRUGATED SIDING
ASFALTSLATE SHINGLES
BUILDING PAPERS

538

Service Exchange

For Manufacturers or Distributors

Editor's Note.—From time to time we receive letters from distributors wishing to be put in touch with manufacturers of certain lines of equipment, or from manufacturers seeking representatives of their products. Items of this kind will be published and names and addresses furnished interested persons upon request.

New Lines Wanted

Representative in northwest desires to handle, on commission basis, line of road building and maintenance machinery, revolving scrapers, tractors, rotary snow plows and V-type push plows.

Distributor covering Wisconsin and Illinois territory wishes to add to present lines. Thoroughly familiar with bituminous materials and equipment for handling.

Wanted, line of street markers or other traffic equipment on exclusive basis by distributor covering New Jersey and New York territory.

Manufacturer's representative, covering Massachusetts, Rhode Island and southern New Hampshire, would like to secure line of speed reducers and gears.

Wanted, exclusive sales right for state of Mississippi for line of automatic or self-loading wheeled scraper.

Sales engineer, experienced in earth-moving machinery, desires connection on salary or salary and commission basis. Wide acquaintance with machinery dealers, oil and gas industry, pipe-line contractors and material men. References.

Warehouse facilities for serving Pittsburgh territory. Would like to secure line of portable and stationary conveyors.

Wanted, agency for any type of building specialties or contractors' machinery except mixers. Twenty years' experience. Familiar with all types of contractors' machinery. Could act as sales manager for Atlantic coast line with dealers.

Distributor situated in Virginia wishes to make connection to represent manufacturer of manganese crushing plates and jaw rock crushers.

Export manager for American manufacturer of road graders is in a position to handle an additional line of non-competing construction machinery, for manufacturer seeking foreign representation.

Manufacturer's representative situated in New York City, now handling pumping machinery, would like to take on two or three additional lines serving the same field as his present account.

Manufacturer's representative with 25 years' sales experience, conversant with all types of pumps and their field, desires agency for either New York or export territory or both.

Representatives Wanted

Manufacturer of power shovels and well drilling machines is seeking distributing agency for several Nebraska, Iowa and Minnsota counties. Write for details.

Manufacturer of complete line of construction equipment, mixers, saw rigs, plaster and mortar mixers and pumps has an open territory in the state of Maine and is looking for an aggressive distributor to represent him there.

Manufacturer of complete line street repair equipment, tar kettles, heaters, patching plants, torches, etc., has open territory in southeastern states and desires active distribution. Territory largely open from Virginia to gulf states, inclusive, also state of Oklahoma.

Eastern manufacturer of grade-rippers, scrapers and road hones has desirable territory open for distributors.

California territory available for distributor wishing paving expansion joint account.

Good, unassigned territory available for distributors and manufacturer's representatives to handle paving expansion joint line.

Manufacturer of transverse testing machines desires to build up distribution organization in this country and abroad.

Several desirable states open. Wanted, distributing organizations covering entire states by manufacturer of mechanical spreader.

Territory open in several states for representatives to handle grade-rippers, mechanical plows.

Manufacturer of patented luminous highway danger signs and signals is interested in securing aggressive representation in various parts of this country and Canada.

Manufacturer of steel dump bodies and oil heaters seeking distribution points in west central and southern states, including Missouri, Kansas, Iowa, Nebraska, Colorado, Kentucky, Tennessee, Mississippi, Arkansas, Louisiana and western half of Illinois.

Manufacturer of nationally advertised construction equipment offers an excellent opportunity to experienced equipment salesmen to start in their own business. Very little capital required. Several important cities now open for immediate action. Full particulars. Address, Box 1637, c/o Roads and Streets, 420 Lexington Ave., New York City.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912,

Of Roads and Streets, published monthly at Milwaukee, Wisconsin, for April 1, 1931.

State of Illinois,
County of Cook, ss.

Before me, a Notary Public in and for the State and county aforesaid, personally appeared E. S. Gillette, who, having been duly sworn according to law, deposes and says that he is the business manager of the Roads and Streets and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 411, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are:

Publisher—Gillette Publishing Company, 221 East 20th Street, Chicago, Ill. Editor—H. P. Gillette, 221 East 20th Street, Chicago, Ill. Managing Editor—C. T. Murray, 221 East 20th Street, Chicago, Ill. Business Manager—E. S. Gillette, 221 East 20th Street, Chicago, Ill.

2. That the owner is: (If owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding one per cent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a firm, company, or other unincorporated concern, its name and address, as well as those of each individual member, must be given.)

Gillette Publishing Company, 221 East 20th St., Chicago, Ill.; H. P. Gillette, 221 East 20th St., Chicago, Ill.; E. S. Gillette, 221 East 20th St., Chicago, Ill.; Mrs. R. W. Hume, 303 S. Stone Avenue, LaGrange, Ill.; Winifred Gillette, 1125 Oak Grove Avenue, San Marino, Calif.; Commonwealth Title Insurance & Trust Co., Chestnut & 12th Sts., Philadelphia, Pa.; Louise Forsythe, 13 E. Winderemere Terrace, Lansdowne, Pa.; LaVerne Louer Hellyer, Ambassador Hotel, Chicago, Ill.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are: (If there are none, so state.)

None.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

5. That the average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers during the six months preceding the date shown above is (This information is required from daily publications only.)

E. S. GILLETTE.
(Signature of business manager.)

Sworn to and subscribed before me this 27th day of March, 1931.

KITTIE C. WOULFE,
(SEAL) Notary Public.
(My commission expires Feb. 8th, 1934.)